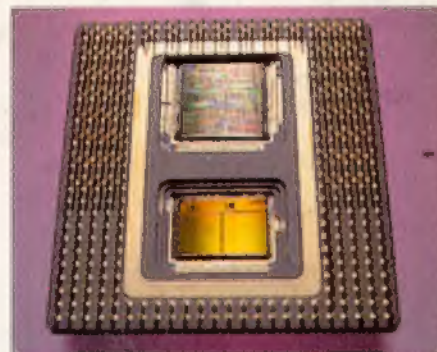




EDITORIAL
LIBRARY

First Looks at P6 Machines

They're Here, They're Hot!
First Pentium Pro Systems
From Dell, HP, IBM, Micron



NETWORK EDITION

Video Speedsters

23 Affordable
Graphics Boards

Videoconferencing

New from Intel,
PictureTel, & Vivo

MAGAZINE

The Top 103 Windows Machines

PC Labs Tests Windows 95 and 3.1 Desktops
From 52 Leading PC Companies



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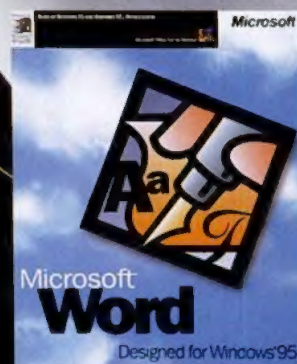
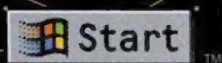


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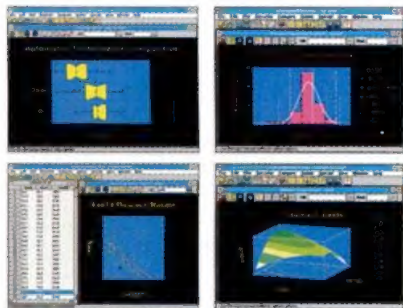


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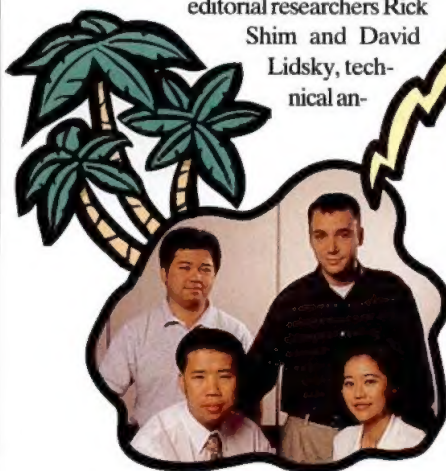
As 1995 draws to a close, the wave of industry mergers and acquisitions, the hype of the Intel Pentium Pro (née P6) processor, and the hurrah of Windows 95 have not obscured the fact that the desktop PC business is healthier than ever.

For this year's roundup of PCs we pulled in more than 100 machines from 52 vendors.

As always, the task of testing and evaluating the latest desktops fell to our PCs team, led by associate editor Carol Venezia and project leader Rich Fisco. In our West Coast lab, project leader Alex Ho oversaw day-to-day testing, assisted by technical analysts Amy Leung and Kason Leung and support technician Russell Iwanchuk. Rounding out the team were staff writers Bob Anthony and Bill Flanagan, staff editors Anush Yegyzarian and Mary Behr, editorial researchers Rick Shim and David

Lidsky, technical an-

out new versions of our industry-standard PC benchmarks, Winstone and WinBench, developed by our sister organization, the Ziff-Davis Benchmark Operation. Like its previous versions, Winstone



East to west: Our bicoastal PCs team.

96, Version 1.0, uses scripts from real applications to produce an overall measure of a PC's performance under Windows—either Windows 3.x or Windows 95. WinBench 96, Version 1.0, provides detailed performance information on all of a PC's major subsystems: processor/RAM, graphics, disk, CD-ROM, and full-motion video.

Our tests found that the machines offer more and better features at considerably lower prices than last year's group. All in all, a good year indeed.—*Jake Kirchner*

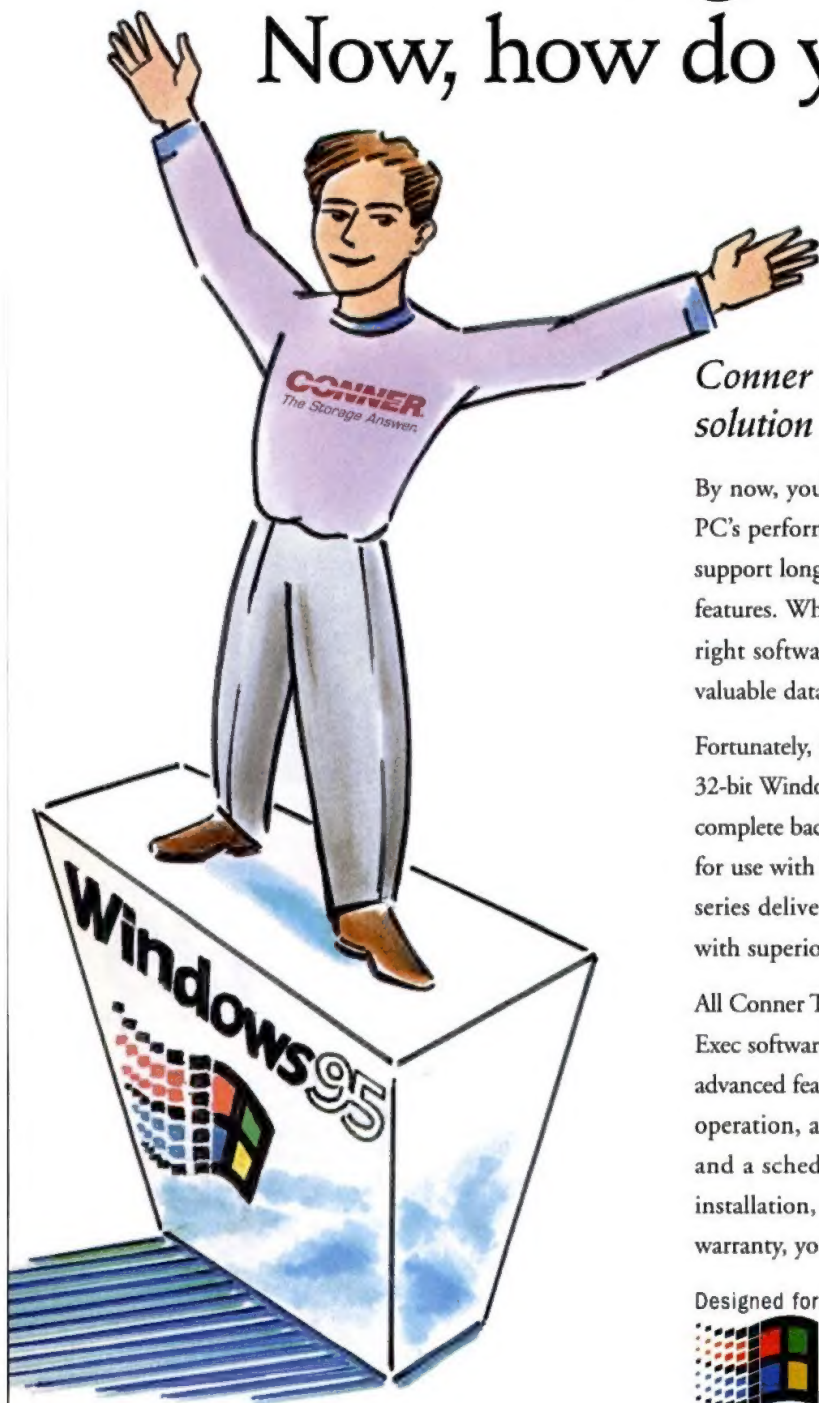
alyst Margaret Piemonte, and contributing editors Bruce Brown and John Quain.

Testing more than 100 PCs is never an easy task. We added further complexity to the job by rolling

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Photo left by Andy Freeberg, photo right by Thom O'Connor; illustration by Mark Matcho

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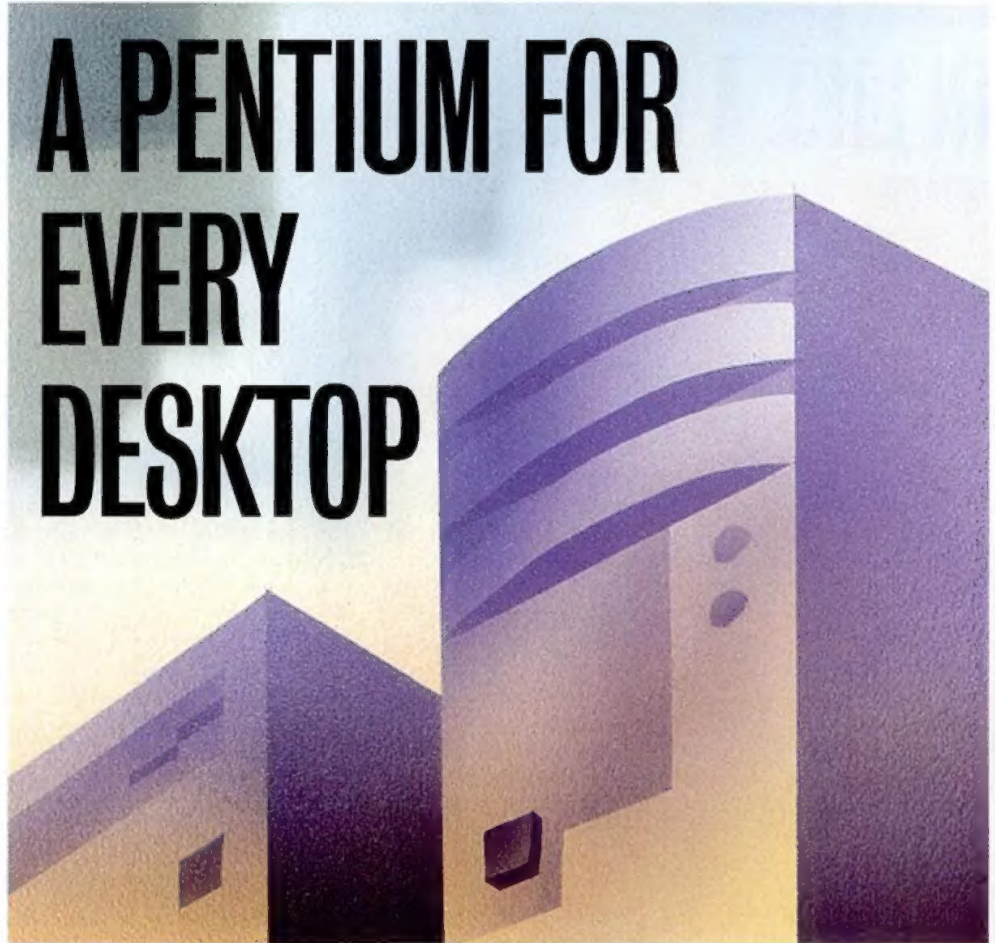
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A PENTIUM FOR EVERY DESKTOP



BY JIM SEYMOUR

Whether you decide to join the new generation of Windows 95 users or stick with Windows 3.x for a while longer, if you're buying a new PC your processor of choice will most likely be a Pentium. In this roundup of 103 Pentium PCs from over 50 vendors, PC Labs puts 20 network-ready corporate machines running Windows 3.x, as well as 83 PCs equipped with Windows 95, through their paces using our new benchmark tests102

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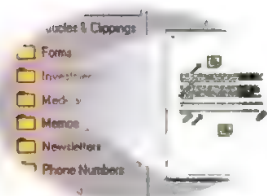
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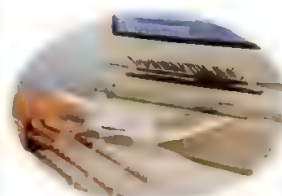
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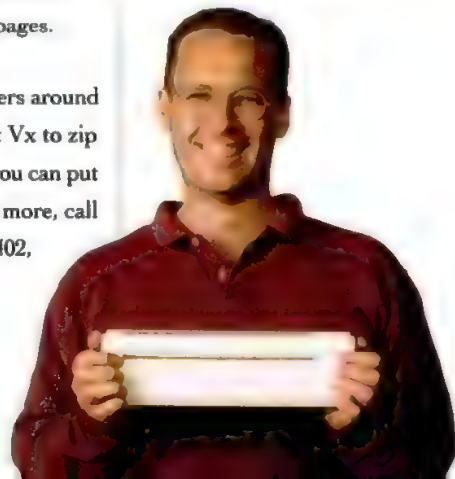
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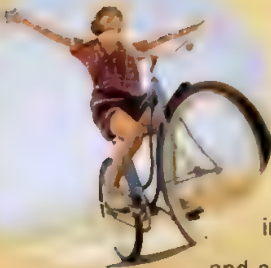
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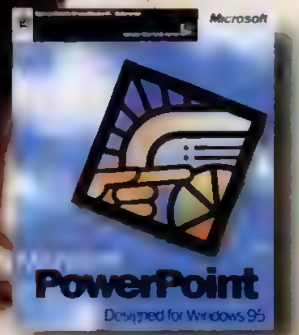
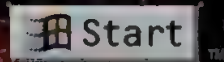
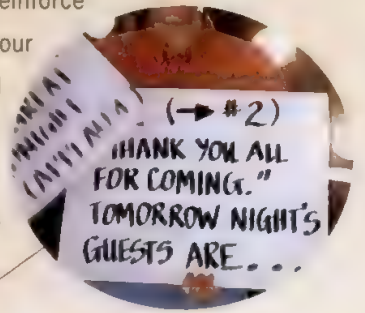


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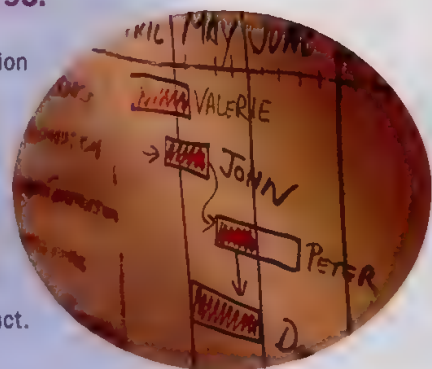
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to guide your project down a clear path

Introducing new Microsoft Project for Windows 95.

Now you can manage projects more simply, more smoothly, by communicating project information as it occurs. With new Microsoft® Project you can convey project status quickly and effectively so your boss, customers, and coworkers are always in the loop. From sharing task deadlines and responsibilities, to letting people know about changes and the impact they'll have on the deadline, you have the tools to organize your projects into manageable steps and keep them moving in the right direction. New Microsoft Project unlocks the doors of communication and gives you the power to navigate the most efficient route to a successful end product.



Graphical views let teammates visualize where the project is going.

With Microsoft Project you can display project data in ways that everyone can understand. Great-looking Gantt Charts integrate text, timelines and graphical bars so everyone can see start and finish dates, inter-dependencies and task assignments. Throughout your project, you can also use a

Monthly Calendar report to share your plan in a format that's clear and easy to read. And since Microsoft Project shares many of the same key commands with other Office applications, it will be easy to create schedules and reports.

But if at any time you need help, type in a question and the Answer Wizard gives you the information you need. Microsoft Project helps you illustrate every phase of your project so you and your team keep your goals in sight.



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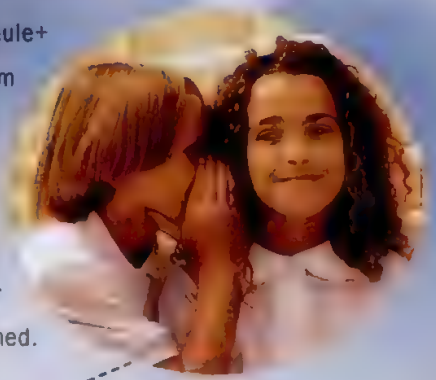


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Keep everyone moving on the same track with open lines of communication.

Microsoft Project is completely integrated with a wide range of e-mail systems* and Schedule+ so that with a single click, changes and additions are immediately distributed to and from teammates. Assignments, task changes, and progress can be communicated and updated without ever reentering information, so you save time and eliminate mistakes. And because Microsoft Project is a member of the Office family, sharing data between programs is easy. For example, you can start building a schedule by simply dragging a task list out of Microsoft Excel and dropping it directly into your Microsoft Project plan. You keep communication clear and information consistent and your project continues to move exactly the way you planned.



 Start



Now you can take full advantage of Windows 95.

Microsoft Project is the world's best selling project management software and now is optimized to work hand-in-hand with the 32-bit performance, advanced multitasking, and simplified user interface of the Windows 95 operating system. Together, they help open the lines of communication. Together, they help you enhance the way you manage your projects.

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CIRCLE 316 ON READER SERVICE CARD

Letters

RAINBOW OF PORTABLES

Thank you once again for an excellent issue devoted to portable computers and printers ("Your Portable Persona," August 1995). One thing I find curious, though, is that notebook computers tend to come with power supplies that automatically adjust between 110/220 voltage, while portable printers do not. For example, if I wish to take your Editors' Choice Canon printer to Europe, I must purchase an \$80 "option". Am I the only one who finds this objectionable?

MOSHE HASPEL,
Atlanta, Georgia

I gleaned a lot of great information from your portables issue; it was a crash course in purchasing, tuning, and using a laptop computer; either on the road or at home. I was also happy to see a new copy of the Road Warriors' Companion. The one that was included in last year's issue is almost worn to a frazzle.

MICHAEL N. HAMPEN,
Pittsburg, California

The special fold-outs in recent issues have been enjoyable to read; I've found the Road Warriors' Companion particularly useful. Regarding your information on place settings, I'm glad to see someone's paying attention to etiquette these days; it's always disconcerting to find oneself without a bread plate because one's neighbor doesn't understand the rules.

LORNA BURNS,
City of Industry, California

Again and again, *PC Magazine* reviewers choose the rough and ready over the carefully integrated; as a result, the subtleties of integration, balance, and design tend to be overlooked. When considering laptops, road warriors care about usability, not CPU speed. Your focus seems to be largely on the future configuration needs of Windows 95. *PC Magazine* evaluates laptops as if they were simply desktops with batteries, rather than the new life companion that laptops have become to some of us!

RAYMOND P. BRIGGS,
via the Internet

DON'T HANG UP THAT FOR SALE SIGN YET

As a dedicated OS/2 user, I do appreciate the balanced coverage *PC Magazine* gives to OS/2 and its applications. At the same time, I have to agree with John C. Dvorak's opinions ("Note to IBM: Sell the OS/2 Division," August 1995). IBM's OS/2 campaign has got to be the worst example of product marketing in history. It's a shame, because OS/2 really is a good product and deserves better support from its own parent. If IBM were to spin off the OS/2 division, the new company would have to depend on the success of OS/2 for its own survival, which in



*When considering laptops,
Road Warriors care about usability,
not CPU speed.*

turn would ensure a much higher level of support for and marketing of OS/2.

DONALD A. TEVAULT,
via the Internet

First of all I'd like to say I'm one of those "most vocal users" Michael J. Miller refers to when talking about OS/2 supporters in his column "The Windows 95 FAQ File" (August 1995). That said, I must comment that Dvorak's column may have hit the nail right on the head. With all of Microsoft's delays in getting Windows 95 to market, IBM had ample time to take advantage of these delays and push OS/2, but it didn't. So maybe the time is finally right for IBM to consider selling its OS/2 division, given the company's apparent corporate indifference toward the product.

BILL HEMENWAY,
via the Internet

There's another practical alternative available to IBM with respect to the future of OS/2: Keep OS/2 alive and breathing but scale it down until that fateful day when Microsoft takes a misstep. And then, presto, OS/2's back in the game again. Cutting OS/2 free wouldn't serve IBM's long-term interests, and it wouldn't serve OS/2's short-term interests. My advice to IBM is to stay on the ropes; your time will come. In the meantime, just don't bleed OS/2 dry.

R. WALKER,
via the Internet

Admittedly, IBM has not done a great marketing job with OS/2, but to say that OS/2 would be better off on its own is absurd. OS/2 needs IBM's leveraging ability and financial

strength in order to become a product that can be fully competitive. Many of the corporations that run OS/2 are IBM customers. As for fanaticism about OS/2, Dvorak calls OS/2 users paranoid, and then on the next page, in his Inside Track column, he writes about how Intel is secretly hoarding memory chips as part of a huge conspiracy to take over the computer industry. Will wonders never cease?

CHRISTIAN CHEN,
via the Internet

STEP UP TO THE BAR

Your recent utility WinBar is an awesome little program ("A New Look for an Old Friend," Utilities, September 12, 1995). The utility makes it easy to configure a Windows 3.1 machine at work to match a home machine already on Windows 95.

CHIP LAROCHE,
Fairfax Station, Virginia

Kudos for an excellent utility. I am using a 40-MHz 386SX system with 8MB of RAM. It works for what I need to do, which is good since I cannot afford to upgrade just to use Windows 95. As time passes, people like me are going to be left further and further behind. Please keep producing excellent Windows 3.1 utilities like this one. I can only hope shareware and commercial software producers will not forget about those of us who believe that Windows 3.1 remains good enough for our present needs.

ARTHUR E. DAVIES,
via the Internet

I have to compliment you on your WinBar utility. At first, I downloaded it just to see what it was all about, but I was, to say the least, very impressed with what WinBar could do. Although it's not exactly like the Windows 95 Taskbar, it's extremely close.

JAMES E. SHIPLEY,
via the Internet

EXAMINING YOUR ROOTS

As a computer genealogist, I find that your recommendations for programs designed to record your family history are somewhat incomplete ("Recording Your Family History," After Hours, September 12, 1995). I agree that Family Tree Maker, despite some weaknesses, deserved inclusion because of its existing broad user base. But there are other, more powerful Windows products available on the market than those you looked at. And if you intended to expose readers to the genealogy powerhouse equivalents of Word or WordPerfect, then The Master Genealogist and Roots IV, each of which recently underwent a transition from DOS to Windows, warrant attention.

CLIFF WATTS,
via the Internet



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Letters

We were thrilled to receive a four-star rating for Family Tree Maker, reviewed in your After Hours section. As indicated in the review, Family Tree Maker is the only program that can help you find your ancestors. But I'd like to clarify the way that the program accomplishes that, as your review was unclear on that point. The FamilyFinder Index of 100 million names is indeed integrated into the Family Tree Maker Deluxe Edition. The Index tells the user exactly which historical record contains additional information about each of the 100 million names listed. What is separate is the records themselves, as they are far too lengthy to fit onto the program disk.

In the upcoming version that was mentioned, the searching mechanism for the records will be integrated into Family Tree Maker, but the 45 CD-ROMs will remain as separate accessories.

CLAIRE LABEAUX,
Marketing Communications Manager,
Banner Blue Division,
Broderbund Software, Novato, California

THE TIMES THEY ARE A CHANGIN'

There's a changing of the guard afoot (Pipeline, "The Revenge of the Nerds," September 12, 1995). I always read Robin Raskin's Pipeline column with interest, and I'm disappointed to learn that she will no longer be writing her regularly insightful, informative, sensible column. Alas, I hope she continues to write for *PC Magazine* more often than "from time to time." Good luck to Raskin in her new venture at *Family PC*. And good luck to Jake Kirchner—he's got a tough act to follow.

JACK SCHARF,
Fort Collins, Colorado

HOW TO CONTACT US

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CORRECTIONS AND AMPLIFICATIONS

The calendar in Starfish Corp.'s Sidekick 95 (First Looks, "Sidekick 95: Power and Grace in a PC", October 10, 1995) goes to the year 2029, not 1999 as we stated.

In our roundup of Web servers ("Windows NT-Based Servers: What's the Rush?" October 10, 1995), the Editors' Choice and the review of O'Reilly & Associates' WebSite both incorrectly stated that WebSite lacks multithreading capabilities. Also, contrary to what the Editors' Choice stated, The Internet Factory Commerce Builder does not lack multithreading. In determining the Editors' Choice, though, multithreading was not the deciding factor.

Our introduction in the same roundup misstated that Netscape Communications Corp.'s Netscape Commerce Server was the only product we reviewed that supports Secure Sockets Layer (SSL). As stated in the review of the The Internet Factory's Commerce Server, this product also incorporates full SSL.

In our story "The Bottom Line on Windows" (October 10, 1995), the fact file for the review of Intellisoft's Accounting Vision/32 incorrectly stated the price of the Systems Manager module. The correct price is \$1,995. In the features table of the same story, the correct estimated street price (10-user license) for Solomon Software's Solomon IV for Windows is \$13,500. On the second benchmark chart on the left-hand side of page 287, the Best and Worst titles should be reversed to be consistent with all the other charts. Finally, in the sidebar, "Report-Writer Report," the product by Synex Systems should be F9 The Financial Reporter and not F9 Report Writer as we stated, and the correct phone number is 800-663-8663.

The correct phone number for Claris's Easy Business Cards (New & Improved, October 10, 1995) is 800-544-8554.

The Second Looks column (October 10, 1995) is unclear on the compatibility of Symantec Corp.'s pCAnywhere with Windows 95. Only the DOS version of pCAnywhere must be run in the MS-DOS mode of Windows 95; the Windows version is compatible.

In the sidebar to our round-up "Windows NT-Based Servers: What's the Rush?" (October 10, 1995), the correct phone number for the Walter Shelby Group's Tile 1.0 is 301-718-7840.

TENACIOUS CHEERLEADERS

Your comparison of Visual Basic and Delphi ("Visual Basic and Delphi Head to Head," September 12, 1995) was an excellent article, with one exception. It fails to mention that Delphi is also available in a standard edition for under \$200. Many developers will never need the client/server capabilities of the \$1,999 version; for them, Delphi offers significantly more than Visual Basic at a lower price.

BILL SORENSEN,
via the Internet

After reading your review of these two RAD tools, I couldn't understand why you used the Visual Basic add-ons. If you were writing a review of development tools it would have been appropriate. But in a head-to-head comparison between two RADs, they should stand or fall based on their merits or pitfalls.

WILLIAM YOHMAN,
via the Internet

I really liked your head-to-head comparison of Visual Basic and Delphi. As a developer, I found it to be very useful.

ALEXANDER RIABOKRIS,
via the Internet

I've been enjoying your issue of September 12, 1995, tremendously, and the articles on the P6 and Windows 95 tips in particular. I have to

say, however, that your comparative review of Visual Basic and Delphi had insufficient breadth to be of much value to anyone conducting a serious evaluation of these products. There's essentially no discussion of report writers or database administration and query creation tools, which are essential to support client/server design, particularly in a RAD development environment.

SCOTT NICHOL,
via PC MagNet

WEB THREADS

We appreciate that *PC Magazine* included our WebSite product in the review of Web servers ("Windows NT-Based Servers: What's the Rush?"). But we are concerned about a factual error—which was repeated three times—that stated that WebSite lacks multithreading. WebSite's server is certainly multithreaded and was designed that way from the beginning. Our measurements have shown that WebSite can process over 100,000 transactions per hour while servicing 60 to 80 simultaneous connections on a common Pentium/90 system. In addition, WebSite's multithreading exploits Windows NT's symmetric multiprocessing features, so that users find performance scales up impressively on multi-CPU configurations.

GINA BLABER,
Director, Software Products Group,
O'Reilly & Associates, Sebastopol, California

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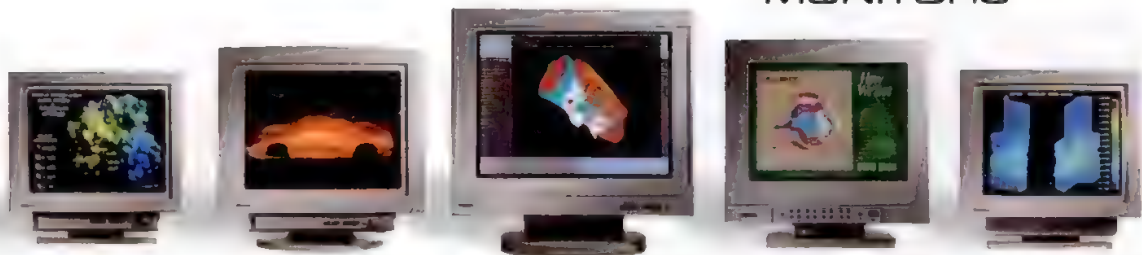
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Pentium® Processor	850C		Pentium® Processor	850C		Pentium® Processor	850C	
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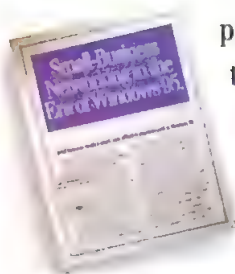
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Trends

TRENDS & TECHNOLOGY SHAPING THE PERSONAL COMPUTER MARKET

Cyrix's Sixth-Generation Chip

The 6x86 targets mainstream desktops.

As Intel's Pentium Pro takes aim at today's high-end workstations and tomorrow's desktops, Cyrix's next-generation 6x86 processor—previously code-named the M1—is headed toward the mainstream PC

market. Cyrix formally announced the 6x86 amid claims that it could compete with Intel's 120- and even 133-MHz Pentium processors.

Because the PC software industry has not completed its evolution from 16- to 32-bit software, the latest generation of processors contains a decided split; the Pentium Pro (code-named the P6) is strictly optimized for 32-bit code, while the 6x86 is honed for 16-bit applications as well as 32-bit software. "People are just not going to throw away their legacy applications," says Michelle Moody, a Cyrix spokesperson. "Both 16- and 32-bit software will be on the desktop for quite some time." Considering the recent release of Microsoft Windows 95—which runs both types of code—the 6x86 should find a foothold in the mainstream desktop market, as the Pentium Pro moves into workstations and servers that run such 32-bit operating systems as Windows NT and OS/2.

PUSHING THE LIMIT

Although the initial release of the 6x86 has a clock speed of only 100 MHz, its performance during Cyrix in-house testing outdistanced both the Pentium 133 and the Pentium Pro 150. On Ziff-Davis's Winstone 95 benchmark tests, the 6x86 delivered a score of 207 under Microsoft Windows for Workgroups and a score of 173 under Windows 95. In similar tests at PC Labs, average Pentium 133 scores under the two operating systems have hovered at 190 and 169 respectively. Cyrix's



The Cyrix 6x86 CPU is as advanced as Intel's Pentium Pro, plus it's honed for 16-bit as well as 32-bit applications.

claimed speeds have yet to be confirmed in PC Labs testing. Cyrix estimated Pentium Pro scores to be from zero to 20 percent lower than those of the 6x86. "Our approach is to wring the most out of our design," says Moody, "because we are using semiconductor fabrication processes that are a step behind Intel's."

Faster 6x86 processors, however, are on the way. Toward the middle of the fourth quarter of 1995, Cyrix will ship the 120-MHz 6x88 (known internally as the M1r), whose die size will be roughly half that of the 100-MHz model. By the middle of 1996, Cyrix will shrink the die another 33 percent and increase clock speeds to 133 MHz. "The current production model has a die size comparable to the Pentium 66,"

says Cyrix's Bill Blagdan, marketing director for the 6x86, "and delivers Pentium 133-level performance. As we decrease the die size, we will not only increase clock speed but increase yield as well." An increase in yield, in turn, will lower prices and raise volume, attracting greater support from major PC manufacturers. Currently, only AST Research, Epson America, and the German-based Peacock Computer are slated to produce 6x86 systems, but expanded production of the 120-MHz chip could be enough to garner additional customers.

SIMILAR DESIGNS

Like the Pentium Pro, the 6x86 is a superscaler, superpipelined processor that supports register renaming, out-of-order execution, and multibranch prediction. Although the Pentium Pro can, under optimal conditions, process three x86 instructions per cycle and the 6x86 processes only two per cycle, Cyrix claims that these rates of execution are actually comparable. "Intel uses a RISC-like architecture that converts x86 instructions into micro-operations before they are processed," explains Cyrix spokesperson Moody. "We, on the other hand, do not require such a conversion." The only other major characteristic that is present in the Pentium Pro but not in the 6x86 is a built-in L2 cache (the Pentium Pro's dual-cavity design incorporates either a 256K or 512K secondary cache memory that is wired directly into the processor). Cyrix, however, does not have plans to develop such a feature. "The market we've chosen to target does not require more than a primary cache," says Moody.

The first 6x86 processors shipped to system vendors at the end of last quarter and are currently available in packages of one thousand at \$450 per chip. This is about 30 percent lower than the Pentium/120. By November, 6x86 machines will be on their way to stores and in competition with Intel's high-end Pentium PCs. "The bottom line on the desktop," says Steve Tobak, vice president of corporate marketing at Cyrix, "is that we expect to outperform both the Pentium 120 and the Pentium 133 across the board." Any desktop void left by the Pentium Pro is quickly being filled.

—Cade Metz

Pipeline By Jake Kirchner

Night of the Living Dread

It's several days before the end of Daylight Savings Time, and I'm lying in bed, my eyes wide open. The digital clock next to me says it's 2:07 A.M. But a dim flashing light in the hall tells me that two rooms away a VCR silently insists upon a different time: 12:00...12:00...12:00...

I go back to sleep knowing another "intelligent device" has gone berserk.

You have to ask yourself how these things can be intelligent when half the time they don't even know what time it is. After all, telling the time seems to be their primary purpose. Why else do they all have clocks? Is it really necessary that my television, the



VCR, the cable box on top of the VCR, the stereo amplifier next to the cable box, and the video camera sitting next to the amp all have clocks?

I don't know about yours, but my house is full of these things. As I stood alone in my kitchen the other day I suddenly noticed I was surrounded by four of them—a telephone/answering machine, a refrigerator, an oven, and a microwave—each insisting on its own different version of the time. I yanked my electronic watch up to my face—"Good grief!" I said aloud. "Five different times!"

Meanwhile, throughout the house, half a dozen machines keep up their cultlike electronic chant: 12:00...12:00...12:00. They don't need reprogramming, they need deprogramming. Yes, I know I should reset them all, but there are just so many of them, and it's not like you really need 40 or 50 clocks in your house. They don't all have to be synchronized and set accurately, even if you could possibly do so. I won't go into how much trouble it is to get around the fact that my phone system has been

set to block all calls to toll numbers, including Correct Time! And I won't comment on how hard it is to synchronize the four separate clocks in my car.

For a while it looked like the PC would rescue us. The concept was that what we now call a personal computer would evolve into some sort of superintelligent device combining a PC with a telephone, a CD, an answering machine, a television, a video game player, and so forth. Some of that has happened, but the PC simply is outnumbered; sales of intelligent devices are outpacing PC purchases ten to one.

The fallback hope was that the PC could be used to coordinate all those devices. Progress is being made in that area. Although Microsoft's much-touted Microsoft at Work initiative hasn't gotten off the ground, Novell is making some headway with what it calls Nested NetWare.

Novell—which by the way says intelligent device shipments soon will out number PC sales by more than 50 to 1—now is working with several hundred companies to network a wide variety of devices in your office, your home, and your car.

You can see the logic and the attraction of this approach. Every electronic device in your home could be running under the same network operating system. Every device could be linked through your home's electrical and telephone wiring, television cable, and wireless links. Your PC or some other central device becomes a single point of control. With luck your PC won't also become a single point of failure, but first things first.

These are the serious thoughts in my mind as I drift off to sleep. A few hours later I wake up with a start. The sun is up! I've overslept, probably missed my train. A power failure during the night must have thrown off my alarm. Quick, I wonder, how late is it? For goodness' sake, what time is it? Not to worry—the trusty clock next to my bed knows exactly what time it is: 12:00...12:00...12:00...

Jake Kirchner is the editor of PC Magazine.

Judge Rules on Electronic Copyrights

IN A RULING THAT COULD SET A broad precedent for future rulings on electronic copyrights, a federal judge in San Jose has handed down a preliminary injunction against a former minister at the Church of Scientology who posted portions of church documents on the Internet. U.S. District Judge Ronald Whyte ruled that Dennis Erlich, who has gone from Scientology minister to Scientology critic, infringed on the church's copyrights by posting church documents deemed by the church to contain "trade secrets." The injunction restricts Erlich from further postings of the material, although the judge did order the return of disks and other material seized from Erlich's home.

Judge Whyte's ruling is one of the highest-profile legal decisions yet regarding posting of copyrighted material on the



unmanaged Internet. At the same time, the ruling preserves much of the gray area surrounding electronic copyrights in cyberspace. For example, Judge Whyte's ruling states that the transgression in Erlich's case resulted from the fact that lengthy parts of

the church's documents—as opposed to smaller excerpts—were posted. Whyte's ruling also stirs up the ongoing legal battles surrounding whether or not on-line service providers share liability.

In many copyright law cases, small excerpts of copyrighted material are considered publishable, while lengthier segments constitute an infringement. Sam Fifer, an attorney specializing in First Amendment law at the Chicago law firm Sonnenschein, Nath, and Rosenthal, says, "Publishing unpublished material when it affects the market for the material often adds up to copyright infringement." The Church of Scientology does charge church members for certain kinds of access to the material.

Recent proposals from the Clinton administration focus on "cyberjackers" who post copyrighted material, while legislation proposed by Chris Cox (R-California) and Ron Wyden (D-Oregon) aims to protect service providers from any liability whatsoever.—Sebastian Rupley

Illustration by Rollin McGrail

The Internet Comes to Cable

THE RECENTLY ANNOUNCED PARTNERSHIP of Netscape Communications and @Home, a spin-off of cable giant TCI, is bringing an issue that has been percolating for months rapidly to the fore: providing high-speed, real-time Internet access to consumers via existing cable (broadband) networks. Several other communications companies are dabbling in this area as well. Time Warner Cable and Time Inc. are conducting a trial in Elmira, New York, to bring on-line services and Internet access to consumers via cable TV wiring, and a similar venture is underway at Viacom Cable in Castro Valley, California.

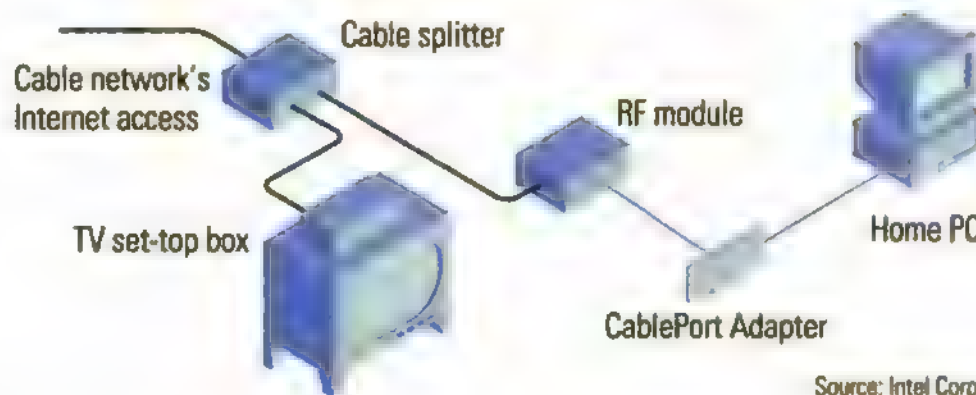
Constructing broadband networks and building consumer awareness are only parts of a complex puzzle. Perhaps the biggest questions are how these services will be delivered, what sort of equipment will be used, and how customers will be charged. The cable modem—now available from LANcity Corp. and Zenith (whose modem is being used in the Time Warner trial) and available soon from Intel and Motorola—is what many consider the missing piece of the puzzle.

In August of this year, LANcity released its third-generation modem, the LCP Personal Cable TV Modem, which transmits data at 10 megabits per second (Mbps), for \$595. "Bringing Internet access over cable, bypassing phone companies, is the next step in high-speed data transmission," claims Ronzbeh Yassini, founder and CEO of LANcity.

Motorola expects to ship its first-generation CyberSurfer cable modem by the first quarter of 1996. The CyberSurfer is part of a line of hardware products that Motorola plans on selling under the umbrella of CableCom data products. Motorola expects that the first cable CyberSurfer unit will cost about \$500. Intel is also on deck with its CablePort Adapter, the technology that was licensed from Hybrid

High-Speed Internet Access

Intel's CablePort Adapter transmits data at 27 megabits per second over existing television cable wiring. The rollout of Internet and on-line services over cable networks will occur regionally and will cost from \$25 to \$40 a month.



Networks. The CablePort Adapter, which transmits data at 27 Mbps, should be available by the spring of 1996. "We believe that set-top boxes are dying," says Matt Diethelm, business manager for Intel Corp. "These modems will be a way to bring high-speed Internet services into the home. They will create networks as opposed to point-to-point connections."

One of the biggest challenges facing

this burgeoning product group is the development of standards. "Standards are mandatory," says Diethelm. "It's hard to predict how long the standards will take to develop, but I think we'll get the first generation of cable modems out there and then agree on standards for the second generation."

For now, the cable modem vendors agree that high-speed Internet access over existing television cable will be delivered by the cable companies. And cable companies have finally tuned in to the new revenue streams that could be opened by this

market. "The last two years, we've worked hard to convince people in the cable industry that there was an opportunity here," says Diethelm of Intel. "The cable companies had rationalized investments in interactive television and telephony." The turning point, according to Diethelm, came

about six months ago, when @Home got started and the cable companies jumped on the bandwagon.

The roll-out of Internet and on-line services via cable networks will occur regionally over a period of several months. Prices for these services are expected to range from \$25 to \$40 a month including the rental of the cable modem itself. —Sarah L. Roberts

The Disposable PC

THE DUMB TERMINAL MAY BE poised for a dramatic comeback, along with a host of new low-end hardware concepts for corporate users and consumers. Both Compaq Computer and Sun Microsystems have plans underway to open up new markets at the extreme low end of the hardware food chain. Compaq has resurrected an idea it explored a few years back for manufacturing "disposable PCs," and Sun is working on designs for what it calls "shell computers," designed to facilitate targeted tasks such as Internet access.

Still in the early design stage, Sun's plans focus on both portable and desktop solutions for accessing—but probably not storing—network-based data and content such

as World-Wide Web pages. Java, the company's C++-based language for creating Web applications and agents, is the key link in the strategy. Applications written in Java can be embedded in Web pages and executed dynamically by clients.

"Today's portable computers carry much baggage that isn't required for quick access to information on the Internet," says a Sun official. "Client-server applications have expanded the horizons, and we think the potential of Java applets is in distributing data and applications with little regard to the hardware you're running." Typically, these devices will consist of inexpensive display technology, a processor, a communications port, and no extra frills such as a CD-ROM drive or hard disk.

A sample Java application that one of Sun's devices might facilitate would be an

applet for making 401K changes on an internal corporate Web page that's linked to a corporate payroll-and-benefits database. The device would "borrow" the applet as a client to facilitate the change. Sun foresees possible pricing for its low-end portable and desktop devices starting at under \$500.

Compaq, too, is targeting rudimentary hardware in the under-\$500 range, which Compaq CEO Eckhard Pfeiffer says is the pricing that will usher in a home-computing boom. Pfeiffer predicts that by the year 2000, the consumer market for PCs will reach \$65 billion a year. Initially, Compaq is aiming its low-end PCs at consumers in Eastern Europe, Africa, and Asia. The inexpensive PCs will be Internet-ready Windows 95 machines, with at least 8MB of memory and no multimedia frills, such as CD-ROM drives or sound subsystems. —Sebastian Rupley

Searching the Web

EVER TRY TO FIND A NEEDLE IN A haystack? It's probably a lot like searching the vast ocean of information on the Internet, a challenge that software developers are gearing up to meet.

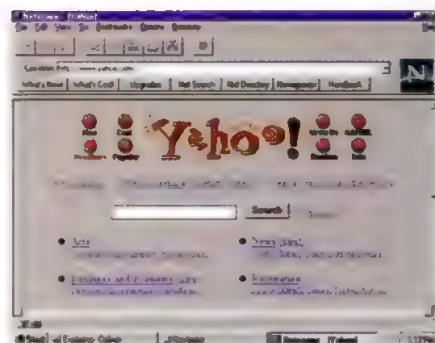
"Indexing the Internet is the single most complex database updating problem ever," says Tim Bray, chief technologist at Open Text, a developer of searching software. Open Text (<http://www.opentext.com>) and Yahoo Corp. (<http://www.yahoo.com>), publisher of a comprehensive directory to the on-line universe, are now sharing their technologies. By combining Yahoo's directory of Web sites with Open Text's full-text search technology, upcoming software will let you launch a search from Yahoo and branch out to the far reaches of the Internet.

Virtually everyone who is on the Internet has poked around Yahoo at some time or other. Every day, Yahoo serves up over 6 million pages to 400,000 users. Open Text, meanwhile, is a full-text indexing tool that can handle multiple languages and has a good grasp of the problems inherent in indexing the Internet. The distinctive characteristic of

Open Text technology is the understanding of document structure, says Bray. The software's "similarity search" feature will find information on the weather in Vancouver, for instance, by knowing that "rainy" or "sunny" are related to "weather." Exactly how the software accomplishes this is the secret recipe, explains Lynda Heij, a software analyst at Open Text. Explains Bray, "The easy parts are searching and finding the results. The hard parts are the indexing and updating, since no one knows how many pages are on the Internet or how fast it's growing."

As part of the agreement, Yahoo will license Open Text's core technology, and the two companies will collaborate on future context-sensitive search tools.

Meanwhile, IBM has announced InfoMarket Search, a service that will retrieve requested information from several Internet resources, including Yahoo, Open Text Index, and 13,000 newsgroups. Additional



Modeled like a table of contents for the Internet, Yahoo is adding full-text search features.

content providers will include Disclosure, a provider of financial data on more than 25,000 public companies worldwide; Comtext, a distributor of hundreds of real-time news sources from around the world; and Newsbytes, an international computing and technology wire service.—Carol Levin

Cyberspace Magistrates Are Proposed

IN AN INCREASINGLY LITIGIOUS world, arbitration is gaining favor over formal legal proceedings as a method of resolving disputes. The same may soon come true for the Internet as virtual law in cyberspace comes to reality. At a recent meeting at the Georgetown University Law Center in Washington, D.C., a panel of legal and technology experts recommended that Virtual Magistrates, or teams of private arbitrators, be formed to resolve intellectual property disputes on-line. While the recommendation focused specifically on copyright and intellectual property disputes, it may be a first step toward widespread acceptance of cyberspace arbitration.

The Georgetown panel included legal and technology experts, including MCI's Vint Cerf (often called the Father of the Internet), Georgetown University law professor David Post, and America Online's director of public policy Bill Burrington, among others. The panel's consensus was that copyrights and intellectual property should be protected on-line by current laws, which echoes recent comments regarding on-line copyright infringement made by members of the Clinton administration.

But the panel agreed that applying current laws in cyberspace could slow the free flow of cyberspace information. The idea is that on-line arbitration could provide a more flexible and less time-consuming approach to resolving disputes than litigation.

The panel agreed that the Virtual Magistrates should hear claims in real time and report back to on-line service providers whether the claims justify removal of on-line material pending investigation. On-line service providers would likely be very much in favor of such a process, as the liability of service providers has been an issue in recent cyberspace copyright cases.

Legislation currently being considered in Congress is targeted to protect service providers from any liability whatsoever—including liability in copyright-infringement cases—for postings and deletions. The Copyright Clearance Center (<http://www.copyright.com/>) facilitates copyrights for thousands of documents distributed on-line and works closely on related issues—such as metering—with publishers including Reed-Elsevier. Also, The Center for Democracy and Technology (<http://www.cdt.org>), the Electronic Frontier Foundation (<http://www.eff.org>), and the Electronic Privacy Information Center make available information on copyright protections and related legislation.

One panel member, Helena Kobrin, lead counsel for the Church of Scientology, has been involved in several high-profile copyright-infringement cases in recent months over internal church documents, and Kobrin said that the courts are overburdened, and dispute resolution short of going to court is a hot area right now.—Sebastian Rupley

Top Retail Software

Current ranking	Last issue	Product/company
1	—	MS Publisher for Windows 95 3.0 Microsoft Corp.
2	1	SoftRAM 95 Synchronys Software
3	2	MS Plus! for Windows 95 Microsoft Corp.
4	6	Procomm Plus for Windows 2.11 Datastorm
5	8	WordPerfect 6.1 Upgrade Novell Inc.
6	—	WinFAX Pro 4.0 Delrina Technology
7	—	Dashboard 95 1.0 Starfish Software
8	—	VirusScan for Windows 95 McAfee Associates
9	—	Uninstaller 3.0 MicroHelp
10	—	MS Windows NT Server 3.51 Microsoft Corp.

This list ranks PC business programs according to the total number of copies shipped to over 12,000 stores and resellers in the week ending September 30, 1995; the list cannot be interpreted as a picture of the entire software market. Adapted from a compilation by Ingram Micro.

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DOS

- MS-DOS 5.0 and IBM PC compatibility



Data Comm

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LapLink Remote

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ec:Mail

- Carry e-mail or on-line services with you built-in ec:Mail Mobile



Pocket Quicken

- Manage your finances anytime, anywhere. Track business and personal expenses, link to desktop Quicken



Lotus 1-2-3

- Lotus spreadsheet, including graphics, macros, and database commands



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CIRCLE 271 ON READER SERVICE CARD



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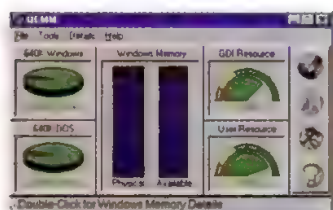
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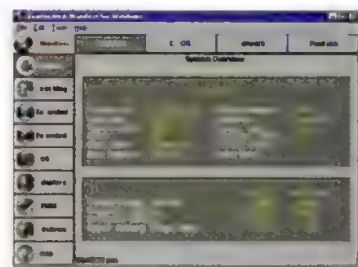


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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

FIRST PENTIUM PRO SYSTEMS

Intel Raises the Bar: Pentium Pro Systems Arrive

By Sebastian Rupley
and Brian Nadel

The tests are done and the numbers are in on the first crop of systems based on Intel's Pentium Pro processor, the successor in many respects to the popular Pentium CPU. For this comparison, we put the first four 150-MHz Pentium Pro machines—Dell's Dimension XPS Pro 150, Hewlett-Packard's HP Vectra XU 6/150C, the IBM PC 300 Pentium Pro System, and the Micron Pro 150 Magnum Plus—through their paces at PC Magazine Labs and found that these initial systems reflect a wide range of designs and approaches to optimizing for this new CPU.

Running the workstation-class, 32-bit software for which they're optimized, even the slowest 150-

MHz Pentium Pro systems we looked at provide more than a 30 percent performance leap over the typical 133-MHz Pentium machine. Running 16-bit software narrowed the performance difference significantly.

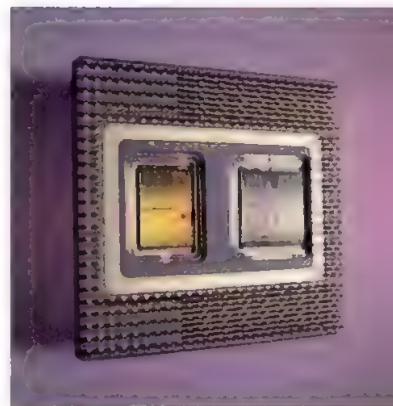
32-BIT OS REQUIRED

Top-flight performance, yes, but because the Pentium Pro prefers a 32-bit OS—such as Microsoft Windows NT—over Windows 3.x, it was not made to run in a typical

mainstream PC. All four of the systems appearing in this roundup use Windows NT and come packed with large hard disks and 32MB of memory, although for the more graphics-intensive portions of our testing we used 64MB of RAM.

Beneath the hood, the Pentium Pro is a mix of old and new technology. The chip's most unique feature is that in addition to its 16K of internal cache, the Pentium Pro's dual-chip module contains 256K of external cache. The processor contains 5.5 million transistors, about twice that of the Pentium design, and is about three orders of magnitude more powerful than the 8086 chip. But the initial 150-MHz version that powers these systems is built on a 0.6-micron BiCMOS

Continues on page 38



CACHE ON-BOARD: The packaging of the Intel Pentium Pro processor integrates 256K of external cache in addition to the chip's built-in 16K of internal cache. The dual-chip module design speeds memory access for enhanced performance.

NETWORK PRINTERS

HP LaserJet 5Si: Quick on the Network Draw

By Edward Mendelson

Hewlett-Packard Co.'s LaserJet 5Si series of 600-dot-per-inch (dpi) network laser printers wins speed records with its 24-page-per-minute (ppm) output and outmaneuvers the competition with superior paper handling. A 103-pound behemoth, each of the 5Si models has a remarkably friendly face, with drivers that support watermarks and thumbnail printing in either PCL or PostScript mode and network software that lets you cancel jobs in progress.

These cutting-edge workgroup printers come in two flavors: the basic \$3,499 LaserJet 5Si and the tested \$4,899 5Si MX, which adds Adobe PostScript and HP's JetDirect print-server card. Both models look virtually identical from the outside and are compact at 21 by 21 by 20 inches (HWD). From the paper trays to the two-line LCD control panel, everything about these units feels solidly built and elegantly machined.

According to HP, the 5Si line is

able to handle a duty cycle of 100,000 pages a month without strain; its toner cartridges are rated at 15,000 sheets. The JetDirect print-server card, standard in the 5Si MX, connects to LocalTalk and Ethernet (10Base-

Technology. Halftone images print with up to 120 shades of gray, and the output is stunningly detailed. Often, the range and subtlety of shading rivals that of photographic output. The 5Si models' 600-dpi output quality is



NETWORK WORKHORSE: Rated at 24 pages per minute, the LaserJet 5Si MX pumps out the pages. A two-line LCD panel (see inset) displays status.



T and 10Base2) networks. An optional card is available for Token Ring networks. The printers can accept data from more than one network and the Enhanced Parallel Port at the same time and automatically switch between PCL and PostScript modes.

The 600-dot-per-inch (dpi) output looks sharper and smoother than its rated resolution thanks to HP's Resolution Enhancement

about equal to that of the 1,200-dpi prints from Lexmark's Optra printers, except that the fine dot pattern is far more readily visible than it would be at higher resolutions.

Like the LaserJet 4Si, the 5Si units have three paper trays. One 500-sheet paper tray holds up to 11- by 17-inch stock; the other 500-sheet tray goes up to legal

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Pentium Pro Systems

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semiconductor fabrication process that is a step backward for Intel, which uses a more advanced 0.35-micron process for the fastest Pentiums available. Expect to see faster Pentium Pro CPUs after Intel moves to the more advanced process next year.

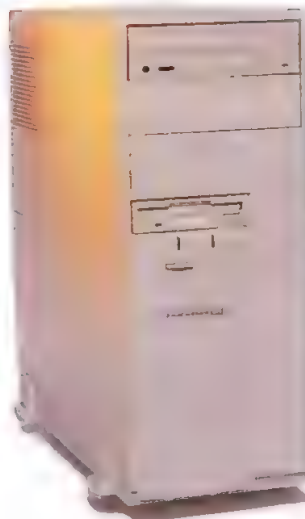
These systems each have their positive and negative aspects. Of the four units we tested, two—the Dell Dimension XPS and the IBM PC 300—use an Intel-designed motherboard, while the Micron Pro 150 uses a Micronics motherboard and the HP Vectra features a homegrown design. In the future, expect to see many systems based on Intel's motherboard design.

MEMORY MATTERS

The Pentium Pro chip's integrated 256K of external cache opens the door for unique memory-subsystem designs, the first of which

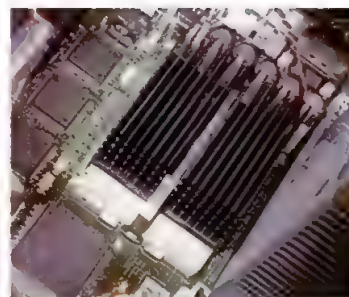
are found in these systems. The HP Vectra's motherboard uses innovative dual inline memory modules (DIMMs), while the other three machines use standard single inline memory modules (SIMMs). By interleaving the DIMMs, the HP Vectra has an ultrawide 128-bit (as opposed to 64-bit) data path from memory.

The HP Vectra was also boosted by the fact that it could utilize a second Pentium Pro CPU in a symmetric multiprocessing (SMP) arrangement. It breezed past the others on some speed tests, especially our Adobe Photoshop tests, where the machine's second processor boosted performance over the other systems by about 40 percent on selected multithreaded tasks. On the other hand, on the non-multithreaded Photoshop tasks, the overhead of managing the extra CPU actually slowed the system down. Along the same lines, the HP Vectra in dual-CPU mode was slower than



in single-CPU mode on our AutoCAD test.

All the systems we tested were plenty fast, and they were significantly faster than our Pentium/133 Micron Millennia reference system. On our CPUmark₁₆ tests of 16-bit processor performance, the



VALUE LEADER: Dell's Dimension XPS was the bargain of the group.

reference Micron Millennia was on a par with each of the systems. That parity was blown away on our CPUmark₃₂ tests, emphasizing that these are fire-breathing 32-bit systems that speed through 32-bit code.

Compared with \$10,000-plus workstations based on chips such as Digital Equipment Corp.'s Alpha, the PowerPC 604, and Sun's UltraSparc, these early Pentium Pro systems foretell a shattering of the entry barriers for workstation-class computing. The performance-leading HP Vectra comes in at a very reasonable \$6,600 in single-CPU configuration and \$8,220 in dual-CPU configuration. At the other extreme, the bargain of this Pentium Pro quartet is the Dell Dimension XPS, which undercut the others by several hundred dollars.

It's very clear that these systems are squarely aimed at workstation users running 32-bit applications, not at mainstream desktop users with 16-bit applications. The individual reviews, feature tables, and performance results that follow give an indication as to each system's strengths and weaknesses. But one thing is for sure: We are only at the start of the Pentium Pro era.

DIMENSION XPS PRO 150

Dell's \$5,199 Dimension XPS Pro 150 extends the line's heritage of leading with new performance-oriented technology at an affordable price. These innovations then filter into the company's corporate-oriented OptiPlex line after they become stable, proven, and more reasonably priced. The Dimension XPS is a basic, no-nonsense PC whose performance was in the middle of the pack. The system provides a boost com-

BENCHMARK TESTS



Pentium Pro PCs

Although each of the four Pentium Pro PCs tested and reviewed offers a performance benefit when compared with a Pentium/133 PC, the clear winner was the HP

Vectra XU 6/150C. It achieved best-of-class scores in most categories and offers the option of dual processing for even more computing power. The Pentium Pro PCs showed an improvement of about 40 to 50 percent over the Pentium/133 reference unit on our CPUmark₃₂ tests.

	Excel Macro Script (seconds)	Word Macro Script (seconds)	CPUmark ₁₆	CPUmark ₃₂	AutoCAD (seconds)	Photoshop Lighting Effects (seconds)	Photoshop Gaussian Blur (seconds)	Photoshop Sharpen Edges (seconds)
▲ Higher scores represent better performance. ▼ Lower scores represent better performance.								
Dell Dimension XPS Pro 150	45.1	27.1	269	417	251.7	38.2	8.2	18.3
HP Vectra XU 6/150C (one CPU)	35.4	24.3	271	423	238.9	41.7	8.7	16.4
HP Vectra XU 6/150C (two CPUs)	38.8	24.0	272	427	239.1	39.9	5.0	8.9
IBM PC 300 Pentium Pro System	43.1	28.2	268	390	243.7	38.0	9.2	16.4
Micron Pro 150 Magnium Plus	44.7	28.1	271	400	246.5	38.7	8.8	16.7
Micron Millennia P133*	47.9	32.8	273	277	350.9	47.4	22.7	15.7

*Reported for comparison.

MICROSOFT EXCEL AND MICROSOFT WORD MACRO SCRIPTS

The test scripts for Excel and Word are macro-driven and perform a number of common operations that mirror real-world operations. The tests are modeled after functions performed on our Winstone 95 Excel and Word test suites. Functions such as spell-checking, font changes, copies and deletes, repaginations, and print previews, among others, are performed in the Word script. Operations such as recalcs, statistical functions, cuts and pastes, and charting are performed in the Excel script. We used 32MB of RAM for these scripts.

CPUmark₁₆ AND CPUmark₃₂ TEST

The CPUmark₁₆ and CPUmark₃₂ processor tests each provide a good indication of a system's ability to perform computationally intense tasks in 16-bit and 32-bit environments, respectively. We used 32MB of RAM for these tests.

AUTOCAD TEST

The AutoCAD test stresses a system's CPU and ability to paint complicated graphics. There are three key areas of our AutoCAD test script: opening 2-D and 3-D drawings, performing 2-D manipulations (including new-entity additions, entity deletions, undo commands, regens, zooms, and pans), and performing 3-D manipulations

(including 3-D view rotations and alterations, the Hide command, 3-D move operations, and several rendering variations). We used 64MB of RAM for this test.

ADOBE PHOTOSHOP TESTS

Testing in Adobe Photoshop involved using three filters. The Lighting Effects filter uses the default spotlight settings, the Gaussian Blur filter spreads out a selection of the screen by an adjustable amount and adds low-frequency detail, and the Sharpen Edges filter finds the areas in the image where significant color changes occur and sharpens them. We used 64MB of RAM for these tests.

First Looks

pared with a high-performance 133-MHz Pentium machine and is the bargain machine in this first roundup of Pentium Pro PCs.

Based on the same motherboard design as that of the IBM PC 300, the Dimension XPS has two major differences for power users: one good and one bad. The good news is the inclusion of parity memory to detect common memory errors. The bad news is that the motherboard holds a maximum of 128MB of RAM—half that of the IBM system. Though for most users this memory ceiling will likely never represent a problem, high-end graphics users may see this as an inherent constraint.

The Dimension XPS comes in a mini-tower case and uses a motherboard-based Enhanced IDE controller connected to the 2GB hard disk and the system's TEAC six-speed CD-ROM drive. Graphics are handled by a Number Nine Imagine 128 video card with 4MB of memory, and a 17-inch monitor.

The system achieved even-handed performance scores. Its CPUmark₁₆ and CPUmark₃₂ scores of 269 and 417 place the Dimension XPS on a par with the IBM PC 300 and the Micron Pro 150, but slightly short of the pace set by the dual-CPU HP Vectra. On the other hand, the system scored well on two of our Photoshop tasks: the Gaussian Blur task and the Lighting Effects task.

Fast, inexpensive, and on the cutting edge of PC technology, the Dimension XPS Pro 150 continues Dell's legacy of providing a lot of PC for the money.

Dimension XPS Pro 150. List price: With Pentium Pro/150, 256K external cache, 2GB hard disk, 32MB RAM, Number Nine Imagine 128, 17-inch monitor, six-speed CD-ROM, \$5,199. Dell Computer Corp., Austin, TX; 800-433-3496, 512-338-4400; fax, 800-727-8320.

Circle 435 on reader service card

HP VECTRA XU 6/150C

The \$6,600 HP Vectra XU 6/150C continues the Vectra XU's reputation as the ultimate PC system for users seeking the pinnacle in performance and design flexibility. The Vectra line was in the vanguard of Pentium systems two years ago, and the latest incarnation

proves that HP still leads the pack with cutting-edge technology. From its optimized PCI bus to its SMP abilities to its innovative memory architecture, the Vectra



XU 6/150C redefines the term high-end PC.

The HP-designed and -manufactured motherboard holds up to 256MB of RAM, and the system uses innovative DIMMs as opposed to the standard SIMMs used by the majority of the PC industry and the other three Pentium Pro systems in this roundup. The DIMM design allows for a 128-bit data path by interleaving memory on alternating memory-access cycles; SIMM designs allow for a 64-bit data path. The HP Vectra's memory error correction code (ECC) guarantees the integrity of the memory's contents and provides for nearly fail-safe operation; none of the other systems reviewed here had ECC and only the Dell Dimension XPS had parity memory.

If you look carefully at the HP Vectra's motherboard you'll see that there are four PCI slots in addition to the three ISA connectors. All other PCs are limited to a maximum of three PCI slots. HP engineers managed this feat by using computer simulations of the PCI bus to optimize the six-layer motherboard. The result is greater flexibility and expansion potential, although until a greater variety of PCI peripherals are available, the extra slot may go unused.

Although the HP Vectra is filled with many unexpected design touches, three stand out. The sys-

tem uses a gold capacitor to provide power for its CMOS settings rather than a conventional battery. While the system is plugged in—though not necessarily turned on—the capacitor is continuously charged. In addition, system cooling is aided by a pair of scoops that look like they came off of a vacuum cleaner. Because the system di-

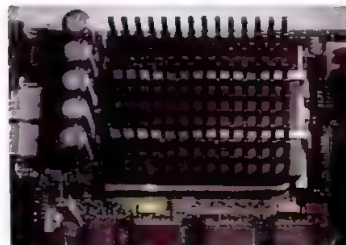


TWO-IN-ONE: HP's Vectra offers a dual-CPU configuration.

rects airflow where it is needed, the unit runs quietly. Finally, the front of the system's mini-tower case has a thumbwheel control for the sound-system's volume—an absolute requirement for multimedia in an office setting.

For those seeking the utmost in PC power, the most interesting aspect of the HP Vectra is its ability to add a second processor. The basic hardware for SMP is on-board the Pentium Pro chip, and HP is the first to utilize this performance-boosting option.

We expect the vast majority of users will choose the single-processor version of the HP Vectra, but it's nice to know that an extra CPU can provide a performance kick if you need one. The upgrade is easy and quick: Just plug the extra chip into the ZIF socket alongside the main processor, load the dual-CPU hardware



PLAIN JANE: IBM's PC 300 is a good all-around basic system.

abstraction layer for Windows NT, and reboot the system. Make sure you have a multithreaded application or you won't get much for your effort.

Across the board, the HP Vectra's test results set the standard. Performance was a toss-up between the single-CPU version and the rest of the pack on the Microsoft Excel and Word Macro Script tests, but the dual-CPU HP Vectra opened a wide margin on the Photoshop tests. Adding in the second processor boosted performance by about 40 percent on multithreaded tasks, such as the Gaussian Blur and Sharpen Edges tasks in Photoshop.

By the same token, the dual-CPU HP Vectra actually slowed down on the nonmultithreaded Lighting Effects task in Photoshop and its AutoCAD timing was slightly slower because of the increased overhead required to manage the second processor.

The Vectra XU 6/150C is the most advanced PC you can buy today. At \$6,600 for a single-CPU configuration and \$8,220 for a dual-CPU configuration, the HP Vectra is the technological steal of today's PC market.

HP Vectra XU 6/150C. List price: With single Pentium Pro/150 CPU, 32MB RAM, 256K external cache, 1GB hard disk, quad-speed CD-ROM, Matrox MGA Millennium, 17-inch monitor, \$6,600; Dual-CPU configuration, \$8,220. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900, 303-635-1000; fax, 800-333-1917.

Circle 438 on reader service card

IBM PC 300 PENTIUM PRO SYSTEM

IBM stakes out the high-performance niche within the middle of the PC market with the no-frills \$6,199 IBM PC 300 Pentium Pro System. In all respects, this is a basic PC but one that provides a



First Looks

significant performance boost compared with the best 133-MHz Pentium PCs available in today's market place.

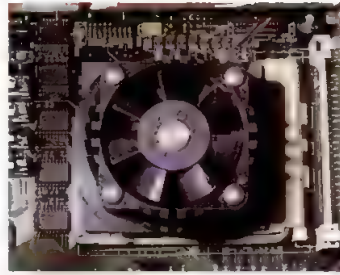
Housed in a mini-tower case, the PC 300 is based on a Intel-made motherboard, which can hold up to 256MB of RAM in its four SIMM slots. With two notable exceptions: First, the Dell Dimension XPS and the PC 300 use the same Intel motherboard. The Dimension XPS's motherboard can hold up to 128MB of RAM, while the PC 300's can hold double that. Second, neither the Dimension XPS nor the PC 300 contain ECC memory, but the Dimension XPS adds parity checking.

The motherboard's Enhanced IDE controller is connected to the system's 1.2GB hard disk and the TEAC six-speed CD-ROM drive. Despite this system's reliance on the Enhanced IDE interface, IBM plans to offer an optional Ultra SCSI controller as well as an assortment of large hard disks.

Microsoft Excel and Word Macro Script tests. Both scores either set the pace or were among the best. On the whole, the PC 300 had scores that were about 30 percent better than those generated by our reference system, the Micron Millennia P133.

The PC 300 also offers a glimpse inside IBM's evolving two-pronged marketing approach for PCs. The PC 300 will be IBM's technology flagship and will be refreshed frequently to include the latest hardware developments, while the higher-priced PC 700 series will be the company's performance and feature leader. Some time in the middle of next year, expect to see the first members of the PC 700 Pentium Pro family, which will be aimed at high-end developers and programmers and will directly compete with the HP Vectra.

In the meantime, the PC 300 Pentium Pro System goes a long way toward fulfill-



HIGH-LOW: The Micron Pro 150 uses some high-end components.

riperals and features that are aimed at the power user. The result is a platform that has a good assortment of features and performs well but falls short of its potential.

The mini-tower system starts with a Pentium Pro Micronics motherboard, which uses Intel's PClset chip set. Equipped with 32MB of RAM standard, the motherboard can hold up to 256MB. But the Micron Pro 150's memory architecture supports neither ECC nor parity checking,



satisfy most power users.

The icing on the cake is a superb Hitachi 21-inch Accuvue UX monitor that includes Ultra-fine dot-pitch technology and an asymmetric shadow-mask design. The monitor supports resolutions up to 1,600 by 1,200 pixels at a refresh rate of 85 Hz. The Accuvue monitor provides a large and pinpoint-sharp view of Windows.

In terms of performance, the Micron Pro 150 achieved middle-of-the-pack results on all tests; the system posted CPUmark₁₆ and CPUmark₃₂ scores of 271 and 400, respectively. The system's AutoCAD score was just slightly slower than that of the single-processor HP Vectra, which was the fastest of the four systems. In many respects, the Micron Pro 150 was held back by its Diamond Stealth64 graphics card, which in true-color mode fell behind the Matrox MGA Millennium (used on the IBM PC 300 and the HP Vectra) and the Number Nine Imagine 128 (used on the Dell Dimension XPS).

Micron, the winner of many Editors' Choice awards over the past several years, has created a high-end graphics workstation that helps set the standard for this new generation of PCs.

Micron Pro 150 Magnum Plus. List price: With Pentium Pro/150, 256K external cache, 2GB hard disk, Diamond Stealth64 Video, six-speed CD-ROM, 21-inch monitor, \$7,397. Micron Electronics, Nampa, ID; 800-388-6334, 208-463-3434; fax, 208-465-8992.

Circle 440 on reader service card

SIDE BY SIDE: SUMMARY OF PENTIUM PRO PC FEATURES

	Dell Dimension XPS Pro 150	HP Vectra XU 6/150C	IBM PC 300 Pentium Pro System	Micron Pro 150 Magnum Plus
Price (tested configuration)	\$5,199 (one CPU)	\$6,600 (one CPU), \$8,220 (two CPUs)	\$6,199 (one CPU)	\$7,397 (one CPU)
Number of CPUs (clock speed)	1 (150 MHz)	2 (150 MHz)	1 (150 MHz)	1 (150 MHz)
Motherboard manufacturer/Chip set manufacturer	Intel/Intel	HP/Intel	Intel/Intel	Micronics/Intel
Maximum RAM/Module type	128MB/SIMM	256MB/DIMM	256MB/SIMM	256MB/SIMM
PCI, ISA, shared slots	2, 3, 1	3, 3, 1	2, 3, 1	2, 3, 1
Parallel, PS/2, serial ports	1, 2, 2	1, 2, 2	1, 2, 2	1, 2, 2
Hard disk capacity and interface	2GB EIDE	1GB Ultra SCSI	1.2GB EIDE	2GB Ultra SCSI
Graphics adapter (and memory)	Number Nine Imagine 128 (4MB)	Matrox MGA Millennium (4MB)	Matrox MGA Millennium (4MB)	Diamond Stealth 64 Video (4MB)
CD-ROM drive vendor (speed)	TEAC (6X)	Sony (4X)	TEAC (6X)	Plexor (6X)

Video is handled by a Matrox MGA Millennium graphics card with 4MB of RAM, and the unit comes with a 17-inch monitor. Our test machine came with Windows NT loaded, but you can order the PC 300 with OS/2 Warp preinstalled instead.

Performance was evenhanded and comparable to that of the Dimension XPS and the Micron Pro 150, but on the whole fell short of the mark set by the dual-CPU HP Vectra. The PC 300 produced midrange scores on the Photo-shop and AutoCAD tests.

The standout scores for the PC 300 were its showings on both the

ing the promise of Intel's Pentium Pro processor.

IBM PC 300 Pentium Pro System. List price: With Pentium Pro/150, 256K external cache, 1.2GB hard disk, Matrox MGA Millennium, six-speed CD-ROM, 17-inch monitor, \$6,199. IBM Corp., Somers, NY; 800-462-2968, 919-517-1331.

Circle 439 on reader service card

MICRON PRO 150 MAGNUM PLUS

The design of the \$7,397 Micron Pro 150 Magnum Plus is a curious melange that is equal parts standard PC fare mixed together with some extreme high-end pe-

both of which are requirements for this class of workstation.

Although an advanced bus-mastering Enhanced IDE controller is included on the unit's motherboard, Micron pushes the performance envelope by adding a state-of-the-art Buslogic BT-930 Fast-20 SCSI-2 controller that is connected to the system's 2GB hard disk and its Plexor six-speed SCSI CD-ROM drive. Top this off with a Diamond Stealth64 video card with 4MB of VRAM and Creative Labs' Sound Blaster AWE32 audio board with Jensen speakers, and you have a multimedia workstation that will

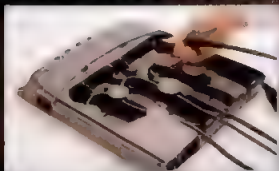
"Have you looked under your desk recently?"

Steve Bass, PC WORLD
Has Plans for the Home
Office, June 1995

APC

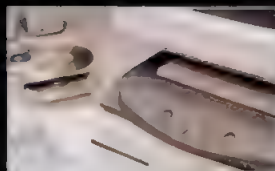
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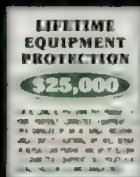


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CIRCLE 182 ON READER SERVICE CARD

First Looks

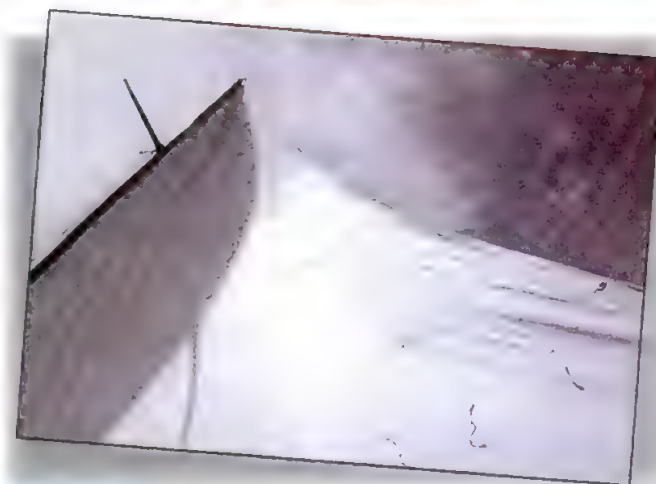
HP LaserJet 5Si MX

Continued from page 37

size; and the 100-sheet multipurpose tray holds up to 11- by 17-inch pages or up to ten envelopes. An optional \$549 feeder can handle 100 envelopes.

A number of tightly integrated paper-handling options add to the power of this workhorse printer. A \$1,299 2,000-sheet paper tray on a four-wheeled base fits below the printer and holds up to 11- by 17-inch pages. Printing 11- by 17-inch pages drops the rated print speed from 24 ppm to 13 ppm.

A multitub mailbox output tray costs \$1,889 and holds 2,100 sheets beyond the printer's built-in output capacity of 500 sheets. In addition, an ingenious \$669 duplexing unit, for legal-size or smaller pages, slips inside the printer and adds nothing to the 5Si units' footprint or height. Because the software drivers support printing multiple pages on a single sheet, the duplexing option makes it easy to print booklets. Duplex print speed, not tested by PC Magazine Labs, is rated at 9.5



SHARP AND CLEAR: The LaserJet 5Si MX's output rivals photographic quality in terms of sharpness and shading.

\$4,070 4520MP and the \$15,000 4230MRP, which produced text at 17.6 ppm and 24 ppm, respectively. Graphics performance was equally stunning. The 5Si MX printed a Harvard Graphics image in PostScript mode at 2.6 graphics pages per minute (gppm) and a CorelDraw 5.0 image at 2.0 gppm—slightly faster than the 4520MP, but slower than the much more pricey 4230MRP.

server card.

Because the basic printer has two expansion slots, one slot on the 5Si MX is open for a third-party card. The LaserJet 5Si can hold up to 132MB of RAM, while the 5Si MX (or the LaserJet 5Si with PostScript installed) can hold up to 76MB.

Many PostScript printers support an optional internal hard disk, but HP goes one better with a \$499 420MB add-on disk that stores both PostScript and PCL fonts. Alternatively, you can use the disk drive to store PCL-based forms for fast printing of letterheads and other graphics-intensive pages. Included fonts match those in earlier models: 45 PCL fonts and 35 PostScript fonts. HP's FontSmart software, now with an improved interface, provides efficient Windows font management and adds 65 additional TrueType fonts.

Software installation is effortless. The HP drivers use a tabbed interface with separate pages for paper selection, font selection, controlling booklet printing, thumbnail printing of from 2 to 16 pages on one sheet, and customizable watermarks that print faintly on the background of each page.

THE OPERATING-SYSTEM FENCE

With both Windows 3.x and Windows 95 drivers in the box, HP evidently believes that corporate America will not immediately embrace Microsoft's new operating system. A new version of HP's JetAdmin print management software lets users at workstations track their print jobs, cancel them from within the queue, and select paper types by descriptive name instead of by bin number.

Users can cancel any of their own print jobs that are waiting in the queue, and the network administrator can pause or cancel any job with a mouse-click. Network administrators can password-lock the printer's control panel, although this feature isn't meant to provide airtight security and can be bypassed by holding down one of the panel buttons while turning the printer on.

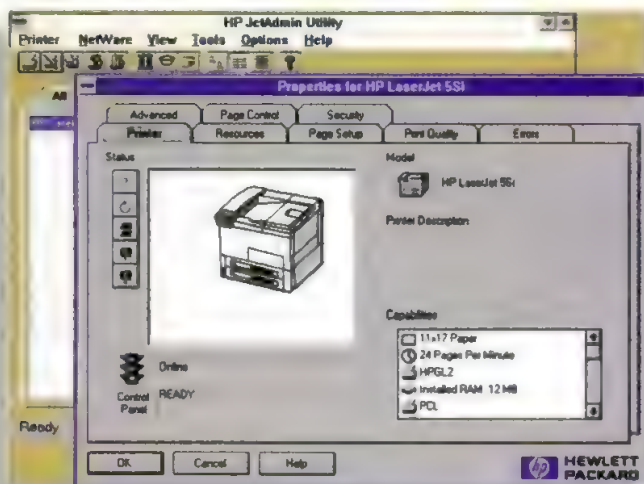
The printer driver automatically adjusts to changes in the hardware configuration instead of waiting for the network administrator to make the adjustment. One nice touch is the traffic-light icon located in the lower-left-hand corner of the interface that gives a quick display of the printer's status.

The JetDirect card includes a flash BIOS for upgrades to support new operating systems; a Windows 95 upgrade for existing JetDirect cards was recently posted on HP's CompuServe forum.

The 5Si family of network printers is solid and impressive and stunningly low-priced in view of its quality. These units are the obvious choices for heavy-duty departmental printing and increase Hewlett-Packard's lead over all competitors in the high-end printing market.

HP LaserJet 5Si MX. List price: \$4,899. Requires: PC with parallel port or network connection. Hewlett-Packard Co., Direct Marketing Organization, Santa Clara, CA; 800-752-0900.

Circle 414 on reader service card



POWER PANEL: Get up-to-the-minute printer information with the LaserJet 5Si MX's JetAdmin Printer Status screen.

ppm for letter-size pages and 6.5 ppm for 11-by-17 stock.

PAGES: FAST AND FURIOUS

The 5Si MX's performance is as impressive as its looks. Using an HP Vectra XU/90C test-bed, our evaluation 5Si MX roared through text at 20.2 ppm. This places it between two of Xerox's popular high-end network printers: the

The basic LaserJet 5Si comes with 4MB of RAM, and HP's memory enhancement technology lets the machines print all the graphic pages we could throw at them. The LaserJet 5Si can be upgraded to the 5Si MX we tested by adding a \$579 SIMM cartridge with Adobe PostScript Level 2, a \$579 8MB SIMM, and the JetDirect Ethernet print-



From November 27 to December 1, go on-line to discuss the LaserJet 5Si MX with HP Printer Division executives and Edward Mendelson, a contributing editor at PC Magazine. Type GO EXEC from any CompuServe prompt.

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There's some kind of cosmic waffle rule that applies to business meetings:

if you reschedule

once, you will have to reschedule a dozen times. Because if it isn't Bob, it's Joan, or Gayle or Jorgé. And meanwhile, the perceived importance of any meeting is inversely proportional to the number of times it is pushed back.

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PROGRAMMING TOOLS

Microsoft Visual Basic 4.0: A Mix of Old and New

By Tom Mace

Visual Basic users have waited years for an upgrade but Microsoft Visual Basic 4.0 (VB) is finally here, and it appears to have been worth the wait. VB 4.0 is now a full-fledged 32-bit programming tool for building Windows 95 or Windows NT applications while it continues to support 16-bit Windows 3.x development. It also ushers in a powerful new OLE-based control format and gives programmers the ability to package their procedures and functions as standard OLE automation objects.

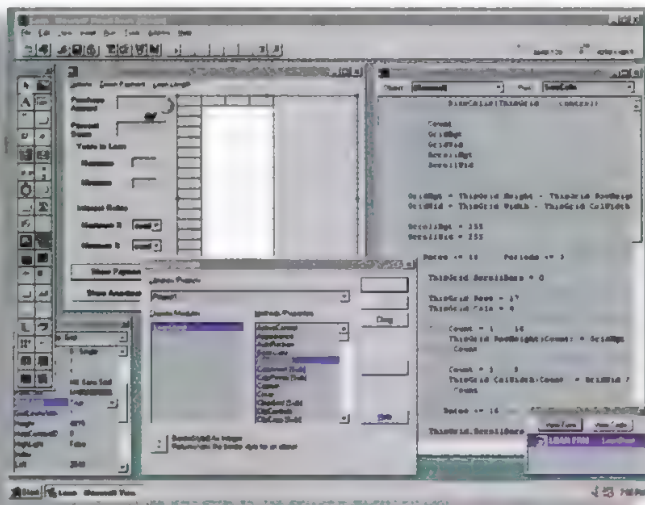
A groundbreaking new technology called remote OLE automation will let corporate developers deploy their OLE automation objects on remote networked servers, allowing a single application to be physically and logically partitioned across multiple locations. This makes VB 4.0 a serious contender for multitier client-server applications.

SMALL, MEDIUM, AND LARGE

VB 4.0 is available in three formats: a \$99 Standard Edition, which includes the programming environment, the basic controls, the Jet database engine, and access to local data formats; a \$499 Professional Edition that adds the ability to create OLE automation objects, a collection of enhanced controls, ODBC support, Microsoft SQL Server drivers, The Microsoft Office Developers Kit, and an enhanced version of Crystal Reports; and a \$999 Enterprise Edition that includes all the Professional Edition features and adds Microsoft's SourceSafe version-control package and powerful remote OLE automation. All three versions

are native 32-bit development systems that can be hosted on and create 32-bit applications for Windows 95 and Windows NT. The Standard edition supports 32-

bit programming only. The Professional and Enterprise editions each support both 32-bit and 16-bit applications.



UP-TO-DATE: Visual Basic 4.0 retains the look of earlier versions of VB but adds many updates, both small and large.

In some basic ways, VB hasn't changed at all. VB 4.0 continues to be an interpreted system that generates pseudo-code (p-code) executables, which are interpreted at runtime by a language engine. It also still firmly eschews the world of object orientation. While you can and should reuse your OLE automation objects, you can't create new classes by inheriting their methods and properties.

The cornerstone of VB 4.0 is OLE. The program has scrapped the 16-bit .VBX control as the basic building block in favor of the .OLE control, or .OCX. These are typically 32-bit controls, although a 16-bit .OCX format also exists. All the controls in VB 4.0 are .OCXs, and the list includes drop-in replacements for all the custom controls included with VB 3.0. Migrating existing projects to VB 4.0 is generally straightforward. When you open the project, VB prompts you to replace the

need an updated .OCX control from the vendor.

While VB 4.0 still does not let you create .OCX controls, the ability to create OLE automation objects goes a long way toward filling the gap. Because these objects can expose a standard OLE interface, they can be browsed and used programmatically by any OLE-enabled application.

VB 4.0's remote OLE targets the creation of partitioned or multitier client-server applications. The idea behind application partitioning is to take the business rules out of your application logic and keep them as separate entities on a remote server. Since remote automation objects, like any VB executable, must be interpreted by the VB language engine, you will probably want to continue using server-based stored procedures for performance-critical code.

Traditional data access, a weak spot in earlier VB versions, has been improved. All VB editions include the enhanced 32-bit Jet database engine from Microsoft Access. Remote client/server operations can be accessed using the ODBC-based Remote Data Con-

trol and Remote Data Objects. Remote Data Objects in particular provide fine programmatic control for accessing Microsoft SQL Server, Oracle7, and ODBC data sources. Four new data-bound controls, a grid, a list box, a combo box, and an OLE control enable more powerful front-end development. Finally, the Crystal Report Writer, a revamped version of the old VB standby, offers several enhancements including the ability to be bound directly to a data control and OLE and MAPI support.

OBJECTIVE FUTURE

The program retains the lumping together of controls in a single palette, but tooltips and right-mouse-button support are provided throughout. The new Object Browser lets you examine the OLE servers referenced in your project. The editor lets you customize highlighting and view your code either as snippets or as a single code block. The Debug window has been enhanced to include editor functionality.

The Basic language is now compatible with the Visual Basic for Applications (VBA) syntax used in most Microsoft applications. New keywords include a With statement, which helps you avoid having to type repetitive lists of properties. New #If and #EndIf statements let you target multiple platforms from a single source-code base with conditional compilation blocks. The new release has also added resource file support to store application strings, bitmaps, and data. This arrangement lets you prepare specialized versions of applications (in multiple languages, for example) without having to recompile the application.

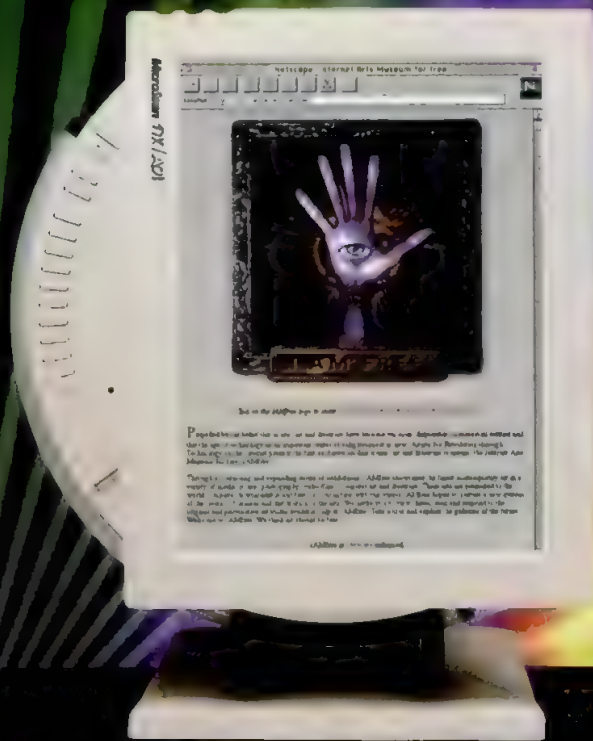
VB 4.0 undergoes a wholesale modernization with the incorporation of OLE controls and OLE automation support. At the same time, it bucks the growing trend toward object orientation and the integration of a true compiler.

Microsoft Visual Basic 4.0. List price: \$999. Requires: 8MB of RAM, 35MB of hard disk space, Microsoft Windows 3.1, Windows 95, or Windows NT. Microsoft Corp., Redmond, WA; 800-426-9400.

Circle 432 on reader service card



From November 20 to 24, go online to discuss Microsoft Visual Basic 4.0 with product marketing manager Chris Flores and with Tom Mace and Jay Munro of PC Magazine. Type GO EXEC at any CompuServe prompt.



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The ADI MicroScan™ 17X monitor puts a whole new spin on the way you work. In seconds, it can switch from landscape to portrait without closing any running applications. Just click on the portrait driver icon, turn the monitor, and hit the degauss button on the front-panel. It's that easy to flip between Internet home pages, word processors, oversized spreadsheets, and other applications—and still get the big picture.

Larger Viewing Area In Its Class

The MicroScan 17X is like getting a 21" display for the price of a 17" monitor. Its vertical viewing area in portrait mode is larger than any 17" or even 21" monitor on the market, and easily accommodates an entire 8.5" x 11", legal or A4 page in portrait view. No need to scroll or print to see the whole page. This means you'll be able to do twice as much in half the time.

High-Quality Feature Set

The MicroScan 17X also has many other things to flip over. Like a 17" CRT display with a 16" diagonal viewing area, 1024 x 768 resolution, flicker-free 76Hz performance, .28mm dot pitch, microprocessor digital controls, even Plug-n-Play compatibility. It's a feature set you won't find in competitively priced monitors. And since ADI builds monitors for leading PC companies worldwide, you know you're making a quality investment for the long haul. The MicroScan 17X is also backed by a three-year warranty. Best of all, you don't have to be a Web Master to get one. Just call 1-800-228-0530 for your nearest dealer.

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CIRCLE 226 ON READER SERVICE CARD

MAPPING

Hit the Road with TripMaker 1996

By Bruce Brown

A number of mapping programs on the market include the ability to route trips, but Rand McNally's \$39.95 TripMaker 1996 Edition combines an easy-to-use mapping tool with a reference program that can help you plan your next car trip in the U.S., Canada, and Mexico. Intended primarily for family and personal travel, TripMaker 1996 is not flexible enough for use as a business tool.

There are several ways to use TripMaker. You can use the Trip Explorer to see slides or watch videos of various attractions and then choose to include them in your trip. Alternatively, you can fill out a series of screens, coached by an odd-looking animated character dressed as a frontier explorer. For fastest trip planning, just fill out a Quick Trip screen, which lets you type in (or choose from a pick list) your origin, destination, and stopover points. Once you've planned a trip you can save it in TripMaker's proprietary file format; TripMaker 1996 is backward-compatible with trip files made in TripMaker 1.0.

The program doesn't let you build in trip segments where you might fly or take a train or boat, but you can get around that shortcoming by breaking land segments of your journey into separate trips, each with its own map, itinerary, and budget. For a whole trip or for any segment, you can choose the shortest, quickest, or the most scenic routes.

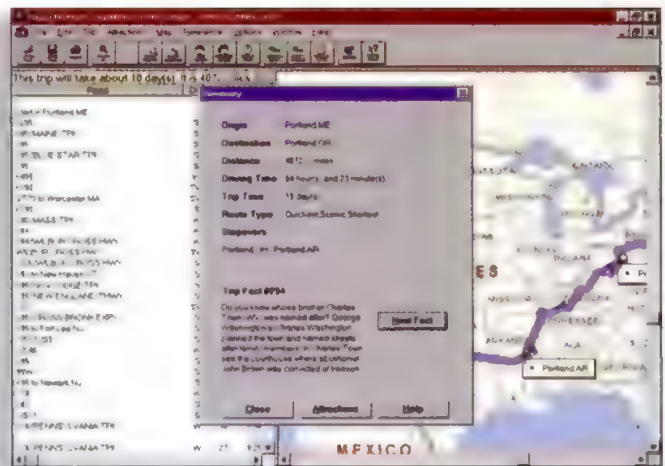
TripMaker's content is its most impressive aspect. There are 640,900 miles of roads, 125,000 cities and towns, and 200 city maps; a coupon for a free copy of the company's road atlas is included. For vacation planning, the program has information on 20,000 attractions, including 900 photos and 200 video clips.

On the downside: You can't find street addresses with TripMaker, but you can use Rand McNally's \$50 StreetFinder 1996, a set of two CD-ROMs that in-

cludes information on hotels and restaurants. Unfortunately, the programs don't share information, but you can jump back and forth between them, using TripMaker to plan car travel and major maps and then using StreetFinder to make local walking maps.

A couple of minor quirks: When you change or move screen components while running the program in Windows 95, occasionally the color palette will be off, with the wrong color on one part of the screen; the solution is to redraw the screen. Another surprise is that the program's tutorial keeps running if you exit TripMaker 1996 without first exiting the tutorial.

If you're about to start plan-



ROAD TRIP: Once you've defined a route in TripMaker 1996, the screen can be set to show part of the map, your itinerary, and a trip summary.

ning next year's vacation, TripMaker 1996 can make the process a fun and informative exercise. **Rand McNally TripMaker 1996 Edition.** Estimated street price: \$39.95. Requires: 4MB RAM

(8MB recommended), Microsoft Windows 3.1 or later. Rand McNally New Media, Skokie, IL; 800-671-5006, extension 402; fax, 716-873-0906.

Circle 437 on reader service card

UTILITIES

Quick View Plus: The One-Stop File Viewer and Converter

By David Haskin

One highly visible improvement in Microsoft Windows 95 is Quick View's built-in support for displaying a variety of popular file formats directly from within Explorer and the File Open dialog boxes. The \$49

pared with the 27 formats supported in the standard Windows 95 version. It flawlessly displayed all the formats we tried, including those created in now-rare programs such as PeachText 5000 and XyWrite.

Quick View Plus displays most

document formatting faithfully, while the Windows 95 version only has a draft mode. If you save a World-Wide Web page to your hard disk, Quick View Plus can either display it with formatting intact or show it with the HTML tags.

You can drag the contents of a displayed file to any open application and

color depths than the current display setting.

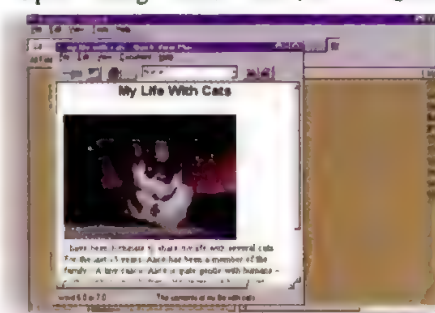
The program can act as a printing clearinghouse by printing any document it can view, even if you don't have the application that created the document. When viewing text documents, Quick View Plus can find text strings you specify within the file.

The main shortcomings include the inability to drag an embedded image to another document, and Quick View Plus doesn't precisely maintain the page layout of compound documents. For example, in a Word for Windows test document, it placed text originally wrapped around an image below the image. Also, it can't perform its dithering tricks on embedded images.

If you frequently view other file formats and must move data among different formats, Quick View Plus is an essential tool.

Quick View Plus. Estimated street price: \$49. Requires: 4MB hard disk space, Microsoft Windows 95. Inso Corp., Chicago, IL; 800-333-1395, 312-329-0700; fax, 312-670-0820.

Circle 436 on reader service card



OPEN VIEW: Quick View Plus lets you view the contents of most files with formatting intact.

Quick View Plus from Inso Corp. adds depth to the selection of formats and is able to read HTML (Hypertext Markup Language) tags.

Quick View Plus (previously called Inside Out for Windows 3.x) can view more than 200 word processing, database, spreadsheet, and graphics formats, com-

maintain formatting, which makes Quick View Plus an excellent format-conversion utility for cutting and pasting either a single line of text or an entire document. In addition, Quick View Plus can zoom and rotate images and alter dithering in the viewing window to make images clearer if they were created with greater

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CD-ROM DISK CHANGERS

Smart and Friendly's CDJ 7004 Shuffles and Deals a Seven-Disk Hand

By Alfred Poor

How many CD-ROMs do you have? If you only own one and have no plans to buy any others skip this review. But if you're like most PC users who have a growing stack of the silver platters and are tired of shuffling the disks in and out of your single-disk CD-ROM drive, the \$349 CDJ 7004 from Smart and Friendly may seem like an attractive solution. The quad-speed CDJ 7004 uses the same seven-disk Nakamichi changer mechanism as the one used by Mountain Network and Ocean Microsystems and costs just a little more than a standard quad-speed drive.

The drive is an external unit with a SCSI-2 interface using the traditional large Centronics-style connectors. There is a DIP switch in the back lets you set the unit's SCSI ID and activate or disable the internal terminator; no external termination plug is required for operation. Stereo jacks let you connect the drive to your computer's sound card.

The front panel has the typical audio jack and volume control, but instead of a single eject button, there are seven—one for each disk. Press any of these buttons and the single tray opens. Put a CD in the tray and close it, and the disk will be inserted into the drive.

As a quad-speed drive, the CDJ 7004 is rated at a sustained data-transfer rate of 600 kilobytes per second, and tests with the data streaming portion of the Microsoft VidTest utility confirmed this performance. The drive is a little slow compared with some single-disk units we've seen, with an average access time of 340 milliseconds.

According to Smart and Friendly, the drive can change CD-ROMs in just 2.5 seconds, but that is just for the physical exchange of disks in and out of the laser reader system. Our tests indicate that the physical

transfer of the disk and directory reading takes an average of about 8 seconds, but can vary based on where the disk of interest is located.

The CDJ 7004 comes bundled with drivers for both PC and Macintosh systems. The PC drivers work with MSCDEX and give each slot its own drive letter. This means that as a result you might have to reconfigure some of your existing software that will expect to see the CD in a dif-



STACK OF DISKS: The CDJ 7004 gives immediate access to seven audio or data CDs.

ferent drive, but this still should be a relatively simple task to accomplish.

The CDJ 7004 also comes with two simple but valuable Windows applications: One lists the disks in the seven slots, and the other lets you select and play audio CDs.

With the CDJ 7004 installed and running on your system, you can have seven of your favorite CDs—audio or data—ready to run at your command and say good-bye to flipping through a stack of disks.

CDJ 7004. Estimated street price: \$349. Requires: PC with SCSI host adapter. Smart and Friendly, Chatsworth, CA; 800-959-7001, 818-772-8001; fax, 818-772-2888.

Circle 401 on reader service card

REMOVABLE STORAGE

Mirror Link Delivers Durable Data

By Daniel Grotta and Sally Wiener Grotta

Mirror Link is an innovative removable hard disk system that uses standard Toshiba 2.5-inch IDE or SCSI drives that fit into an internal or external docking station. The 7-ounce 540MB or 1.3GB data cartridges measure 1 by 3 by 4 inches (HWD), which makes them small and light enough to go just about anywhere and strong enough to withstand 200g of shock.

What distinguishes Mirror Link is that its docking station grabs the data cartridge, the same way a VCR pulls in a videotape cartridge. This is a big improvement over manual insertion systems where too much or too little force could either break pins or fail to make contact. Full insertion and spin-up takes about 15 seconds. The eject button on the right side of the docking station pushes the data cartridge out by about an inch.

Installing the IDE internal docking station took about 20 minutes and was about as easy or difficult as adding a CD-ROM drive. We then popped in the car-

tridge and partitioned it with DOS's FDISK command. Summatec preformats the cartridges. The only difficulty we had was that the enclosed ribbon data cable was too short to reach the IDE controller connector on our test-bed's motherboard.

Adding the external SCSI docking station to another test computer was even easier. We simply attached the included cable and terminator and selected an unused SCSI ID number.



IN AND OUT: Mirror Link's portable data cartridges can hold 540MB or 1.3GB.

Our system already had a primary SCSI hard disk and an ASPI driver, so the 540MB SCSI cartridge was recognized immediately as our second hard disk. We evaluated Mirror Link in both the Microsoft Windows 95 and Windows 3.1 environments and found no difference

in ease of installation or use.

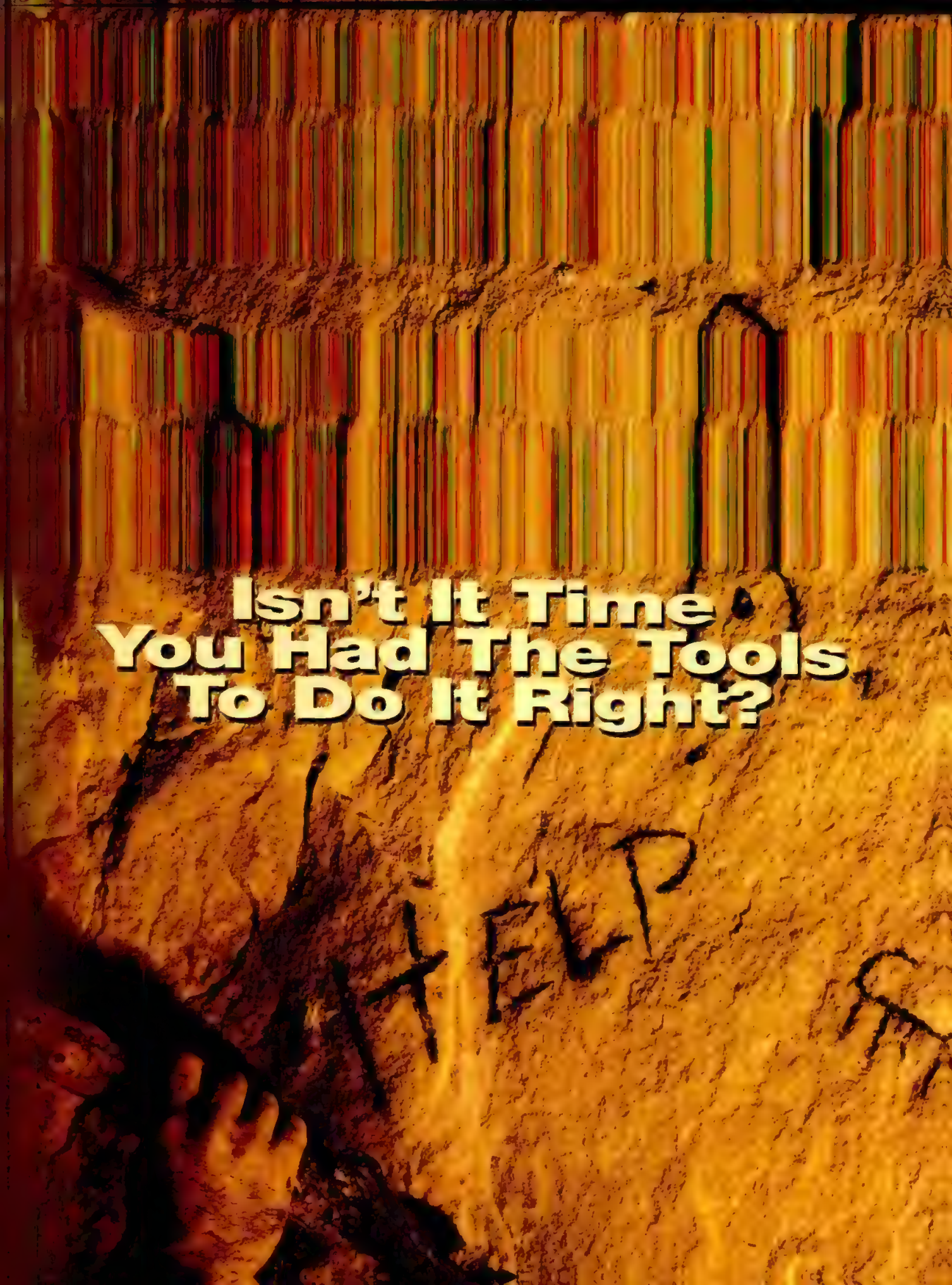
Summatec includes security software that prompts you for a password to remove or insert data cartridges. The Toshiba drives feature a 128K buffer, a 4,200-rpm platter speed, and a 9-millisecond access time. They worked flawlessly after numerous insertions and removals, and even after we accidentally dropped one from a tabletop.

The only downside is price. As the cost of hard disks approaches 25 cents per megabyte, the \$1 per megabyte for the 540MB Mirror Link cartridge is a bit hard to swallow; at 70 cents per megabyte, the 1.3GB cartridge is more reasonably priced.

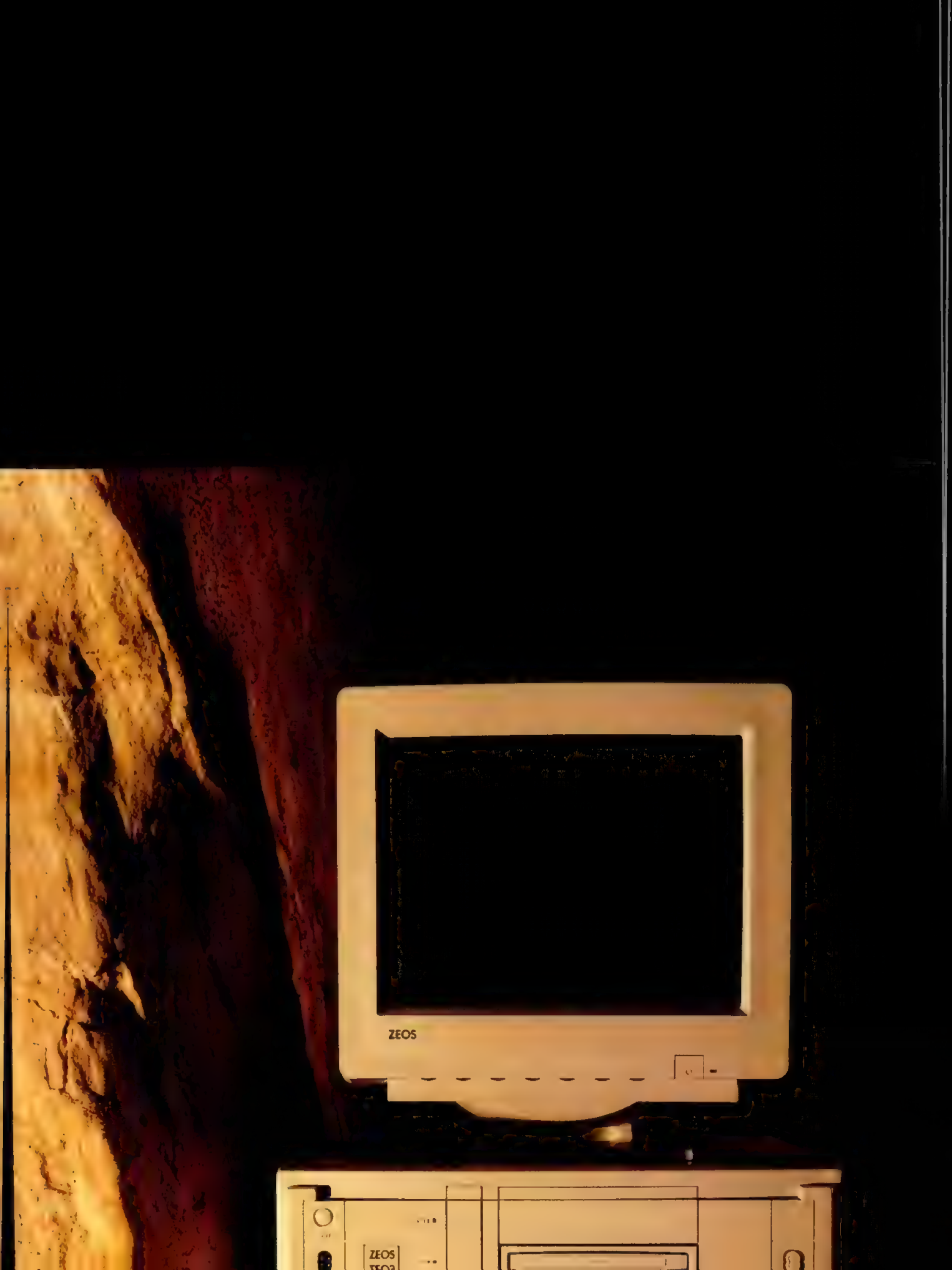
If you need the security and versatility of a removable hard disk system, Mirror Link offers great convenience and trouble-free performance.

Mirror Link 86/DCF-500 IDE cartridge with internal docking station. Estimated street price: \$799. **Mirror Link 96/CF-500 540 SCSI cartridge with external docking station.** Estimated street price: \$829. Additional 540MB cartridges, estimated street price: \$530. Additional 1.3GB cartridges, estimated street price: \$900. Requires: 4MB RAM, DOS, Microsoft Windows 3.1 or later or Windows 95, PC with free internal slot or SCSI host adapter. Summatec Computer Corp., Vista, CA; 800-335-7573, 619-726-7807; fax, 619-726-7903.

Circle 402 on reader service card

A dramatic scene set in a dark, rocky cave. A person's arm and hand are visible in the bottom left corner, reaching out and gripping a rock. The cave walls are rugged and textured, with the word "HELP" written in large, dark, hand-drawn letters. The lighting is warm and focused, creating a sense of urgency and isolation.

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100MHz \$1945	100MHz \$2545	100MHz \$2945	100MHz CNI \$3445
120MHz \$2145	120MHz \$2745	120MHz \$3145	120MHz CNI \$3645
133MHz \$2295	133MHz \$2895	133MHz \$3295	133MHz \$3795
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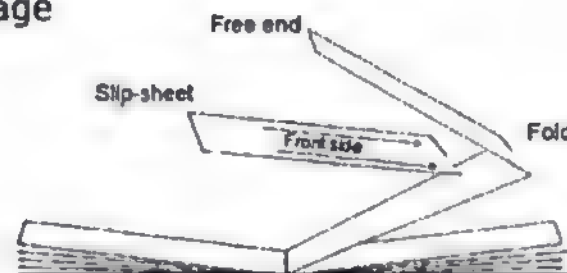
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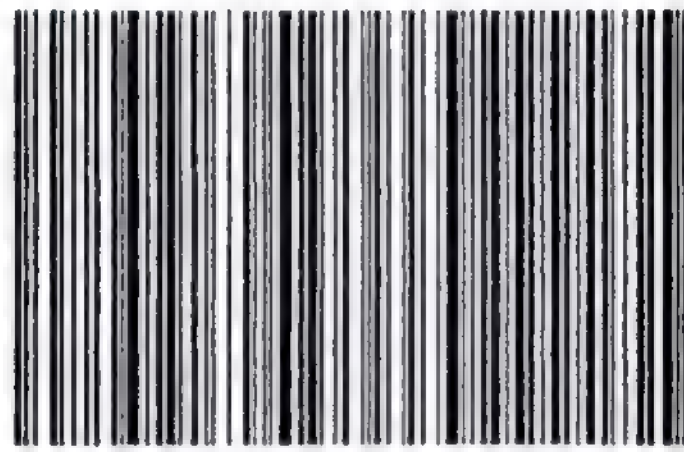


4. Close the page and slip-sheet



1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Folded edge of the page

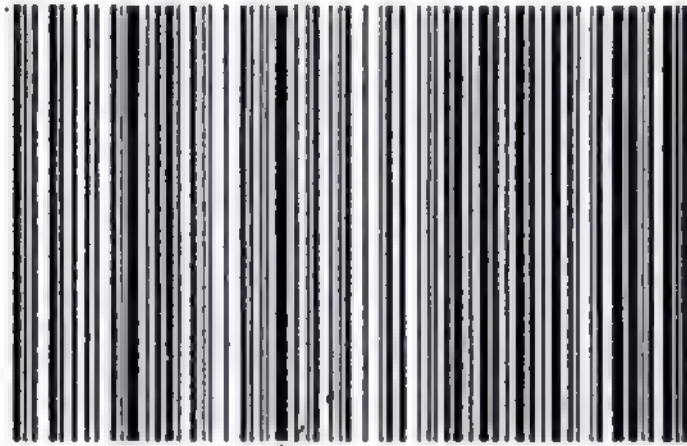


GbsSlipSheet-001

Foldout slip-sheet

1. Follow instructions on the other side

Inverted Back



Gbs5lpBack-001B

Back

1. Follow instructions on the other side

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- 10-bay vertical case (90MHz, 100MHz & 120MHz)
- Microsoft Mouse
- MS Windows 95
- MS Office Pro 95 & Bookshelf® 95 CD



Pantera™
Pentium Processors

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100MHz \$3595
133MHz \$3945

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- Diamond Stealth 64 Video PCI local bus graphics card/2MB VRAM
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- 10-bay vertical case
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- MS Windows 95
- MS Office Pro 95
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*Orders must be for Computers Now! configurations; we've listed just a sampling here. Since we continuously update this list of configurations, please call to confirm your system is on the list. This offer is good only as long as those pre-built systems remain in stock. Other ZEOS systems and custom configurations may take slightly longer—about a week. All orders are subject to credit approval. Monitor upgrades available on all desktop Computers Now! packages. Orders must be received by 1 p.m. Central Time, M-F. Purchase orders are subject to approval. Business leasing programs available. All prices, specifications and availability are subject to change without notice; call to confirm these and warranty details. Prices do not include shipping. *Newell compatibility in Developer Tested Only. Newell makes no warranties with respect to this product. All products and company names are trademarks or registered trademarks of their respective holders. Intel Inside and Pentium Processor Logos are trademarks of Intel Corporation. Windows is a registered trademark of Microsoft Corporation in the U.S. and other countries. ZEOS is a registered trademark. Computers Now! is a registered service mark. Z-Card is a service mark. Panthera, Discovery and Meridian are trademarks of Micron Electronics, Inc. © 1995 Micron Electronics, Inc. A publicly traded company (NASDAQ symbol: MICR). PAN-PCH-9512A

CIRCLE 155 ON READER SERVICE CARD

PRINTER ACCESSORIES

SwatchPrinter 2.0 Makes Perfect Printer Color Matches

By Daniel Grotta and Sally Wiener Grotta

Swatchbooks, those palm-size fanbooks that display a universe of standard colors, are as essential to professional printers, artists, and painters as they are to those who want perfect color matches from their color printer. Trumatch's \$48 SwatchPrinter Software for Windows 2.0 is a simple utility that profiles any color printer, including inexpensive ink jet units, and produces color matches as close to perfect as is possible.

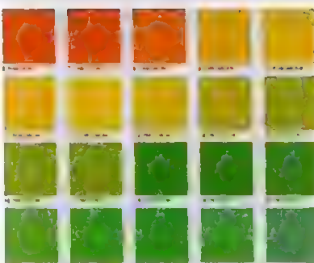
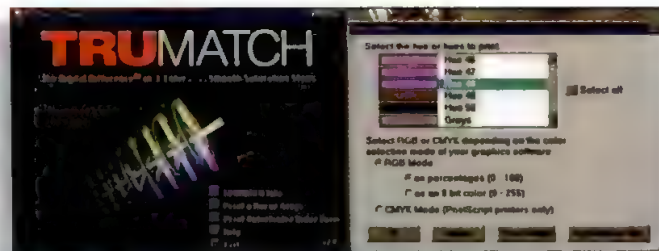
Why do you need an accurate standard-color reference? Because it's the best way to match the RGB (red, green, blue) transmitted colors displayed on a computer monitor with CMYK (cyan, magenta, yellow, black) reflective colors produced by a printer with ink and paper.

Running SwatchPrinter is as easy as it gets: Simply click on the Print button. Then you select a specific range of hues, tints, or shades (such as variations on gold or purple), or opt for a complete printout of all the Trumatch colors your desktop printer is capable of reproducing. Your printer will then kick out up to 26 pages filled with three-quarter-inch color squares. Each printed color sample gives the name and number of the corresponding Trumatch ink, as well as its RGB or CMYK values.

When you choose a color or use the eyedropper tool in Adobe Photoshop, CorelDraw, or other illustration software, don't trust your eyes: Even some calibrated monitors often display colors differently from how they will print. What looks like fire-engine red might print as sunset red or something else. Instead, select your colors from the software palette (most illustration and image-editing programs include the Trumatch color system), using the Trumatch numbers or RGB/CMYK values on the printed sheets. That way, you will know exactly what your

printed picture will look like.

We used a Tektronix Phaser 340 color printer in 300-dot-per-inch mode to test SwatchPrinter and found the program's ability to predict and control colors was uncanny. Although you'll be able to get accurate colors from your desktop printer, SwatchPrinter won't match that output to an imagesetter or printing press. For that, you'll have to persuade your service bureau or printer to run off their own Trumatch color samples, which you then visually correlate with your monitor and printed swatches. Pantone, Trumatch's main competitor, also sells swatchbooks, swatch software,



and calibrated inks. As good as SwatchPrinter is, don't rely too heavily on its on-line information and the two photocopied sheets that pass as documentation.

WYSIWYG COLOR: SwatchPrinter 2.0 correlates your printer inks with your PC.

Regardless of whether you're using a \$500 ink jet printer or a \$15,000 color laser, Trumatch produces the exact colors you want. **SwatchPrinter Software for Windows 2.0.** List price: \$48. Requires: 4MB RAM, Microsoft Windows 3.1 or later, color printer. Trumatch Inc., New York, NY; 800-878-9100, 212-302-9100; fax, 212-302-0890.

Circle 412 on reader service card

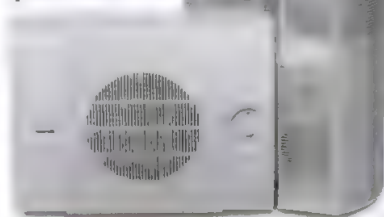
SPEAKERS

Altec Lansing ACS500 Speakers: Turn Them Up Loud

By Steve Buehler

If you're looking for speakers that deliver the full and rich sound needed to complement your high-end multimedia PC, Altec Lansing's \$399 ACS500 Multimedia Speakers give you heart-pounding bass and Dolby ProLogic surround sound but will cost you a lot of desk space.

The ACS500 tower speakers each stand 19 inches tall, with a 5- by 7-inch footprint. These monsters share a 22.5-watt amplifier and con-



BIG SOUND, BIG BOX: The ACS500 surround-sound system engulfs you in sound.

trol circuitry that drives the four speakers that are inside each box. A 3-inch midrange and 1-inch tweeter face front, while a side-

firing 3-inch speaker and a 2.25-by 1-inch oval aimed slightly off-center provide surround-sound effects. A 40-watt subwoofer in a large (6- by 14- by 10-inch) floor enclosure handles low frequencies.

We turned the surround-sound effects off to measure the speaker components and found the ACS500 performed acceptably on our ZD Labs tests. The towers showed a frequency response of 85 Hz to 20 kHz (at 6 dB), good for speakers in this price range. Total harmonic distortion (THD) at 90 dB was 3.98 percent, also good. The bass subwoofer unit was clearly loud but somewhat inaccurate, posting a frequency response of 67 Hz to 700 Hz (at 6 dB) but an average THD of 4.85 percent. Both the tower and bass units improved their THD scores as the volume was turned up, suggesting that these speakers have been tuned for people who like it loud.

When we turned the surround-sound system on, the effect was nothing short of amazing. The Dolby ProLogic circuitry puts the

user in the center of five channels of sound: a center channel, two stereo-imaging channels, and two stereo-surround channels. The overall effect is impressive enough with audio-CD sound but downright scary in the middle of an intense Doom or Descent game session. Any program where action (and the supposed source of sound) occurs just off the edges of the monitor screen becomes psychoacoustically real enough to make the user duck and cringe.

The Altec Lansing ACS500 speaker system is not for users requiring accurate, or quiet, reproduction of sound; a better choice for the audiophile might be the \$339 Bose MediaMates (see First Looks, April 25, 1995). But if you want to get involved in your sound experience and you can give up the desk and floor space this system requires, you'll get some serious surround sound for the money.

Altec Lansing ACS500 Multimedia Speakers. Estimated street price: \$399. Altec Lansing Technologies Inc., Milford, PA; 800-648-6663, 717-296-2818; fax, 717-296-1222.

Circle 411 on reader service card

PRESENTATION GRAPHICS

ASAP Produces Quick but Limited Presentations

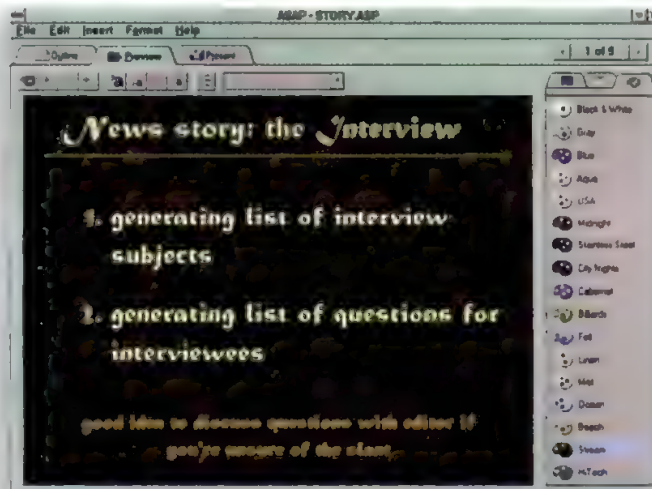
By Sarah L. Roberts

Software Publishing Corp.'s presentation-graphics package, ASAP, is like an over-protective mother who reassuringly grips her child's hand, offering guidance but never letting the child stray. A bargain at \$99, ASAP is designed for three audiences: the complete presentation novice, the user who doesn't put presentations together often, or the user who just needs to get the presentation done quickly. And it works quite well for those segments, but if you want more control over your presentation or delight in the intricacies of design, ASAP probably will seem too simplistic and limiting.

ASAP, which runs under Microsoft Windows 3.x or Windows 95, urges you to plunge right in. There are three views: outline, preview, and presentation. Also included with ASAP are several mock presentations to give you an idea of what a finished presentation looks like and which visual formats work best for portraying different kinds of information. The Keeping Track sample is perhaps the strangest because it attempts to persuade you of ASAP's merit as a simple scheduler program.

ASAP's quick-hit approach to creating presentations is extremely effective. In the outline view, you jot down your ideas about what needs to be covered; you can also start with a word processor file that is imported into ASAP. This view is collapsible, which makes it handy for seeing whether you've hit the major points in the proper order. The outline's use of indented points and subpoints is as easy to do as to undo.

From the outline view, ASAP moves you directly to the preview area where you'll find a staggering array of color palettes and backgrounds, including such gems as City Lights, High-Tech, and Stones. There are 22 layouts and 13 designs included. Combining them gives a wide variety of finished presentation pages.



BY DESIGN: ASAP uses prefab layouts for quick and easy presentations.

Each layout offers advice about what kind of information is best suited to its design. Editing and adding pages to a presentation is straightforward; simply choose Add Page from the dropdown menu and enter the appropriate content. You can also

embed OLE objects into ASAP presentations and add charts from Lotus 1-2-3, Microsoft Excel, Microsoft Graph, or SPC's Harvard ChartXL. To add spark to your masterwork, drop in im-

ages from the Microsoft Clip Art Gallery or your own bitmapped images.

True customization is elusive because ASAP forces you to use its prefab templates. Though you can play around with the presentation somewhat, you'll definitely feel the constraints of the templates. Customizing pages of a presentation essentially consists of replacing the template. In addition, you'll need to head back to the outline view to perform any substantive altering of the presentation text quickly.

So if putting together efficient, consistent presentations with a minimum of time and effort is your goal, ASAP is a sensible choice. But if you like to play with the details of a design, you may be better off picking a higher-end presentation-graphics package.

ASAP. List price: \$99. Requires: 3.5MB hard disk space, Microsoft Windows 3.1 or Windows 95, DOS 5.1 or later. Software Publishing Corp., Santa Clara, CA; 800-234-2500, 408-986-8000.

Circle 404 on reader service card

UTILITIES

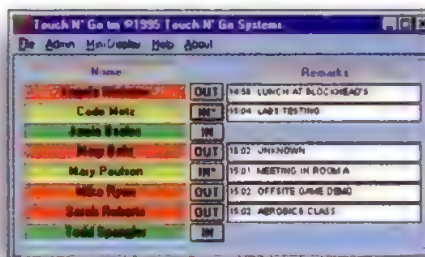
Touch N' Go in the Small Office

By Cade Metz

Like most other manual office tools, the classic in-and-out board that displays each employee's whereabouts has migrated to the PC environment. Touch N' Go, a \$49.95 electronic in-and-out board, lacks the extensive feature set of Futurus Corp.'s aptly named software, WhereAbouts, but it does offer a lucid, easy-to-install interface for monitoring who's where.

If your office has fewer than 20 employees and a NetWare or Microsoft Windows network, Touch N' Go allows you to configure an electronic in-and-out board in a matter of minutes. Both the client and server display a box that lists employee comings and goings. Each em-

ployee has a status button that identifies the person as IN, OUT, or IN*, which signifies that the person is in but not accessible. In addition, Touch N' Go has a Remarks line that shows departure time or specific whereabouts.



WHO'S WHERE: Touch N' Go lists the whereabouts of your office employees.

To change an employee's status button, you merely left- or right-click on the button. If you change the button to OUT or IN*, Touch N' Go launches a small dialog box that lets you

choose from a predefined list of Remarks, or you can type in a new comment.

A common database on the server stores all in-and-out data. Touch N' Go automatically queries the database for updates each minute, but you can manually update your screen at any time.

Touch N' Go's chief asset is its unassuming interface; you can even reduce the main window to a much smaller screen that identifies employees only by their status color. If you desire a more detailed interface or more complex employee-monitoring functions, you should turn to the bulkier WhereAbouts package.

Touch N' Go. List price: \$59.95. Server requirements: 3.5MB hard disk space, Novell's NetWare, Microsoft Windows NT, Windows 95, or Windows for WorkGroups network. Workstation requirements: 45K hard disk space, Microsoft Windows 3.1 or later. Touch N' Go Systems Inc., Anchorage, AK; 800-691-6333, 907-264-6333.

Circle 403 on reader service card

MULTIMEDIA UPGRADE KITS

Diamond Multimedia Ultra Breaks Through the 1-MBps CD-ROM Barrier

By James Karney

Diamond Multimedia Systems' \$649 Multimedia Ultra Kit 8000 contains the first CD-ROM drive capable of data transfers at rates faster than 1 megabyte per second (MBps). The high-performance multimedia upgrade kit, which includes the 8X drive, 32-voice wavetable sound card, a pair of Yamaha YST-M5 speakers, cables, and a variety of software titles, is aimed squarely at the home market and seems right on target.

The performance of this IDE-based upgrade kit sets new standards. The drive produced an outstanding 1.2-MBps sustained transfer rate and a 225-millisecond (ms) access time. Though the access time is a bit slow compared with the average 150-ms rate for quad-speed SCSI-based CD-ROMs we tested, it is acceptable for an IDE drive.

Our tests showed excellent multimedia performance as well. Video playback was smooth and didn't exhibit any drops in the audio track. Sound quality from the included speakers was very good but lacking a bit in bass response; an external subwoofer would have helped here.

The internal CD-ROM drive is made from Philips parts that were assembled in Singapore. Its tray-style CD design eliminates the need for a disk caddy. A nice touch is the inclusion of a pair of speaker-jack converters to attach the sound card's output to the stereo amplifier's inputs.

Of course, multimedia is more than just hardware. The kit includes Magic Carpet, Myst, Rebel Assault, and SimCity 2000, as well as Compton's Interactive Encyclopedia 1996 and a virtual rack of stereo gear: an audio-CD player, a MIDI editor, and a .WAV file recorder.

Diamond has paid a lot of attention to the needs of the end user with this product. There is a quick-start card, a fairly complete manual, and a videotape to aid

you in the installation process.

Getting the drivers to work was the hardest part of the installation. DOS setup was problem-free, but when we tried to play .WAV files under Windows for Workgroups, the system hung. We had to change our test-bed's display adapter to resolve the problem. We also had to play around a little bit with system settings to eliminate conflicts with auto-configuring network cards.

The setup and diagnostic routines provided by Diamond for both DOS and Windows made it easy to change and test settings.

In spite of these minor setup hassles, the Diamond Multimedia Ultra 8000 kit is a winner for those users who want clean video playback and the fastest CD-ROM performance available in the marketplace today.

Diamond Multimedia Ultra Kit 8000. Estimated street price: \$649. Requires: PC with ISA slot. Diamond Multimedia Systems Inc., San Jose, CA; 800-468-5846, 408-325-7000; fax, 408-325-7070. Circle 405 on reader service card



MOVING MEGABYTES: At eight times the speed of a single-speed CD-ROM, Diamond Multimedia Systems' upgrade kit delivers data fast. The 32-bit wavetable sound card (above) provides excellent audio quality.

DATA TRANSFER

DirectParallel Cable Makes The Windows 95 Data Connection

By Steve Rigney

Most users don't have an expensive laser printer, multiple CD-ROMs, and gigabytes of disk space on their notebook, but they might have access to these resources on their office network. Fortunately, you can use the Direct Cable Connection utility in Windows 95 and the \$69.95 DirectParallel Universal Cable from Parallel Technologies to connect two PCs and share data, printers, and other information at speeds close to those of a standard network connection. The DirectParallel Cable works with all types of parallel ports but only at distances of 10 to 20 feet between the PCs.

We connected the DirectParallel Cable between a Dell Latitude

notebook and a ZDS Z-Server EX P90 desktop PC. We used the Direct Cable Connection utility in Windows 95 to configure the desktop as the host PC and the notebook as the guest PC.

During evaluation, we were able to access all of the disk drives and printers on the host PC, as well as its full complement of network resources. These features are built into Windows 95, but the DirectParallel Cable provides the data pipe and speed to make them useful.

In addition to accessing files and printers on the host PC, you can also use the DirectParallel Cable and the Windows 95 Briefcase utility to synchronize files between two PCs. The Briefcase

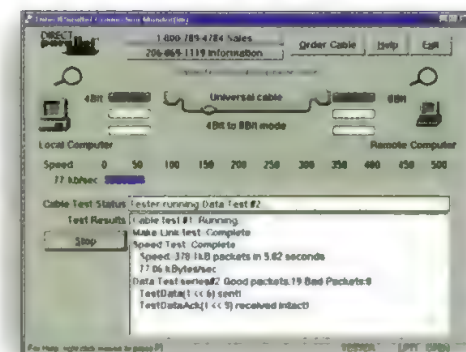
is a fast way to copy only the newest data to your notebook PC before you leave the office or to update those files when you return.

Most file-transfer programs, such as Traveling Software's LapLink, connect PCs via a 4-bit parallel cable, which is limited to a data throughput of approximately 50 kilobytes per second (KBps). Most also don't take advantage of EPP (Enhanced Parallel Port) and ECP (Extended Capabilities Port) specifications.

The DirectParallel Cable uses a new technology that offers a sustained throughput of up to 300 to 400 KBps, which brings it close to that of a network connection. In addition, our testing shows it works with the new EPP and ECP parallel ports as well as the 4-bit and 8-bit ports found on older PCs. The secret behind the DirectParallel Cable's performance and compatibility is the proprietary integrated electronics built into one end of the parallel cable.

Using a parallel cable to connect two PCs has always been an easy way to transfer small bits of data. The DirectParallel Universal Cable provides the speed and compatibility to perform heavy data lifting chores.

DirectParallel Universal Cable. List price: \$69.95. Requires: Microsoft Windows 95, parallel port. Parallel Technologies Inc., Auburn, WA; 800-789-4784, 206-813-8728; fax, 206-813-8730. Circle 406 on reader service card



DATA LIFTER: The Connection Monitor allows you to test the throughput between two PCs.





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¹At lower iCOMP index ratings when upgraded with the Pentium OverDrive processor. *Other trade names referenced are the property of their respective holders.

PCs

Micro Center's PowerSpec PC: The Serious Gamer's Machine

By Jon Hill

The Micro Center PowerSpec PC Reference Series is your quickest route to the cutting edge of multimedia technology. This new design features the groundbreaking Diamond Edge 2200XL multimedia accelerator, which is a PCI card that can accelerate 2-D and 3-D graphics, provide full-motion video playback, and output wavetable-synthesized CD-quality audio. Toss in a six-speed IDE CD-ROM drive, a 1.6GB hard disk, and Labtec surround-sound speakers, and you've got the makings of a next-generation multimedia gaming machine.

The 133-MHz Pentium-based PowerSpec tower system, with a 17-inch Micro Center monitor, sells for \$3,878, making it one of today's high-powered home-PC bargains. For that price, you get a Plug and Play-compatible motherboard with 16 MB of EDO DRAM, 256K of external cache, and an abundance of home software and games.

CARD IN PLACE

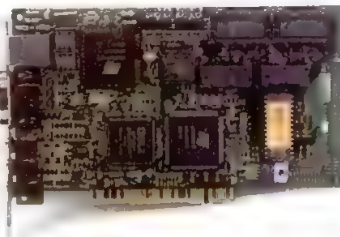
One of the PowerSpec's four PCI slots is occupied by the 2MB DRAM version of the Diamond Edge card, and one of the motherboard's four 16-bit ISA slots contains a Diamond TeleCommander 3500 V.34 modem card. This leaves three free PCI slots and three free ISA slots.

The PowerSpec comes with Microsoft Windows 95 installed,

but unfortunately, the early version that we tested did not include support for any of the Direct X technologies, which could hold the key to the success of this package. The included games and demo programs provide a peek at the sweeping changes that low-cost, real-time 3-D rendering can bring to the desktop.

The heart and soul of the PowerSpec PC lies inside SGS-

POWER TOWER: The PowerSpec system and its Diamond Edge card represent the next generation of high-end home PCs.



Thomson's SGS2000 multimedia accelerator, which resides on the Diamond Edge accelerator card. This DRAM-based version of the Nvidia Nv1 accelerator chip combines the functionality of a standard 2-D graphics accelerator with an engine that can display realistic, texture-mapped 3-D objects. The graphics card also provides concurrent video support for color-space conversion and x-axis and y-axis interpolated video scaling. This packet-based architecture allows graphics, audio, and video data to coexist within a

shared memory buffer. The card integrates a digital game port, a wavetable-based audio codec, and a Sega Saturn game controller.

In theory, the Diamond Edge card has the potential to take the PC to the forefront of gaming technology, but existing games need to be recompiled to take advantage of the accelerator's impressive capabilities. Our test unit



included recompiled versions of Interplay's Descent: Destination Saturn, Papyrus's NASCAR Racing game, and Virtua Fighter Remix but lacked drivers for Direct Draw, Direct Input, Direct Sound, and Direct Video. At present, the list of games that can take advantage of the Diamond Edge's features is fairly small. The Direct X technologies and the upcoming Direct 3D specifications would give the PowerSpec system instant compatibility with any software written to comply with the Windows 95 Game SDK.

We tested the PowerSpec with the full suite of PC Magazine Labs benchmark tests. The system delivered a Winstone 96 score of 58 and a Graphics WinMark 96 score of 15.8 million pixels per second at a resolution of 800 by 600 pixels in 16-bit color mode, a Disk WinMark 96 score of 952, and a score of 270 on both the CPUmark₁₆ and CPUmark₃₂ tests. These results place the system at the center of the pack of 133-MHz Pentium PCs we've tested.

EXCELLENT VIDEO

Video-playback results were uniformly excellent. On test after test, the PowerSpec's Diamond Edge card refused to drop frames or overly burden the CPU. Anecdotal inspection of a variety of randomly scaled clips confirmed the SGS chip's ability to deliver top-quality interpolated video playback. When we ran a demo program that wraps a video stream around a 3-D object at 800-by-600 resolution and 64K (16-bit) color depth, the system was able to map the video stream to a constantly moving and changing object. The system ran out of steam when performing the same task at higher resolution.

The PowerSpec system sits at the crossroads in the evolution of the PC as a serious multimedia platform. On the one hand, its ability to display complex video is unequaled for the price. On the other hand, the system relies on its modem card to provide Sound Blaster-compatible audio for current games.

If Micro Center and Diamond can deliver Direct X drivers for the machine in a timely fashion, the Diamond Edge's impressive hardware will take the PowerSpec to the forefront of multimedia systems. If not, this machine could become yet another example of what happens when the right idea hits the market at the wrong time.

PowerSpec PC Reference Series. List price: With Pentium/133 CPU, 1.6GB hard disk, 256K external cache, 17-inch monitor, \$3,878. Micro Center, Columbus, OH; 703-204-8420; fax, 703-204-8401.

Circle 415 on reader service card

BENCHMARK TESTS



Micro Center PowerSpec PC Reference Series

Equipped with a Pentium/133 CPU, the PowerSpec system produced benchmark test results that were on the whole very close to average. With two exceptions, they were on the low side. The standout scores were on our CPUmark tests; these were slightly above average.

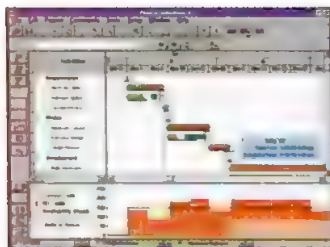
To measure the performance of these systems, we used benchmark tests from Winstone 96, Version 1.0, and WinBench 96, Version 1.0, developed by Ziff-Davis Benchmark Operation (ZD&O). Each system was equipped with 16MB of RAM and ran Microsoft Windows 95.

Higher scores indicate better performance.	Graphics WinMark 96		Disk WinMark 96	CPUmark ₁₆	CPUmark ₃₂
	Winstone 96	(Mpixels/sec)			
PowerSpec PC Reference Series (Pentium/133)	58	15.8	952	270	270
Average Pentium/133 desktop (December 5, 1995)	60	20.0	1,001	266	267

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WORD PROCESSOR ADD-ONS

EndNote Plus 2 Controls Bibliographies and Citations

By Edward Mendelson

EndNote Plus 2 is a complete bibliographic package that manages the wide variety of citation styles required for scholarly papers and journals. Niles & Associates' \$299 program is comprehensive enough to satisfy most academics, but it runs as a separate program rather than as a part of your word processor.

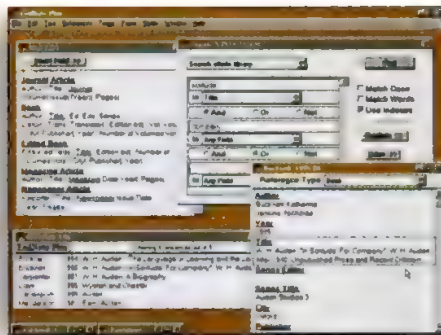
You start by creating a database of books and article titles in EndNote Plus, then use the Windows Clipboard to paste the brief entries from the database into a word processing document. Finally, you return to EndNote Plus and let it process your document by converting the brief entries into citations that conform to the stylesheets of any of hundreds of publications, from *Deviant Behavior* to *Tectonophysics*. The program also appends a correctly formatted list of references to the end of the document. The program's database includes fully customizable fields for entering information about books, articles, maps, computer programs, recordings, or anything else.

Duplicate entries are easily removed, and words and names that you enter often can be chosen from a pick list. You'll have to type in most entries by hand, although the program can import from tab-delimited data files; a \$99 add-on, EndLink2, provides filters for importing entries downloaded or copied from hundreds of on-line and CD-ROM-based indexes and library catalogs.

To use EndNote Plus, you work as you normally do in FrameMaker, Lotus's Ami Pro, Microsoft Word for Windows (including the Windows 95 version), WordPerfect for Windows, or any program that can import and export rich text format files. When you want to insert a citation, switch to EndNote Plus, highlight an entry in a citation database, and press the Windows Clipboard copy shortcut (Ctrl-C).

Back in your word processor, you paste the citation in place. You

have to remember not to modify this citation, because EndNote Plus uses it when reformatting your file. When you're through, close the file in the word processor and batch-process the file from the menus in EndNote Plus. The program saves a separate copy of the file with formatted citations and a list of references, which is the program's major annoyance. Any revisions you make to the formatted copy will be lost if you reformat the



20/20 FORE-GITE: EndNote Plus 2 handles a wide variety of academic footnote styles.

original for another journal. WordPerfect's Table of Authorities feature is much better integrated into WordPerfect but isn't flexible

enough for uses other than legal work.

Despite EndNote Plus 2's minor inconveniences, it's the most powerful citation manager you can find, short of a personal librarian.

EndNote Plus 2. List price: \$299. Requires: 4MB RAM (8MB RAM recommended), 3.5MB hard disk space, Microsoft Win-

dows 3.1 or later. Niles & Associates Inc., Berkeley, CA; 800-554-3049; 510-559-8592; fax, 510-559-8683. Circle 410 on reader service card

UPGRADES

Recycle Memory with Three SIMM Adapters

By Sheryl Canter

If you're thinking of upgrading your PC's motherboard, it won't take long to discover that the most annoying and most expensive surprise may be that your 30-pin single in-line memory modules (SIMMs) won't work with the 72-pin connectors used on new PCs. Does this mean that you have to buy all-new memory modules even though your old SIMMs are perfectly good? Not

Not all SIMM adapters are created equal, however. SIMMStack and SIMMSaver are nearly identical, and both have buffering logic on the board to manage data transfer. By contrast, SIMM-Verter is a pass-through device, which accounts for its lower price.

All three adapters are very easy to use: Just snap in your old SIMMs and plug the module into the motherboard's memory slots. The only snag is that SIMMSaver

array of sizes and orientations so they can mate just about any DRAM module with just about any motherboard. The most varied product line—35 types of adapters—comes from SIMM-Saver Technologies, whose founder and chief engineer invented SIMM-adapter technology and holds the patent. SerMax comes in second with 15 adapter products.

Older three-chip SIMMs that use a composite memory scheme can present timing difficulties with Pentium systems. The makers of SIMMStack and SIMMSaver each warn that those members of their product lines that don't have on-board buffering can't be used with these SIMMs. Cameleon Technology could not confirm whether its adapter would work with three-chip SIMMs.

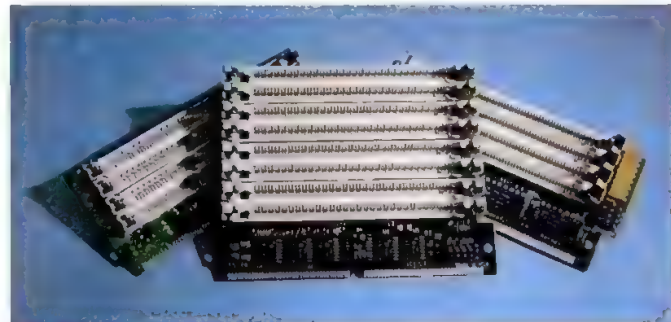
SIMM adapters are a boon to those upgrading to motherboards that require paired SIMMs.

SIMMSaver. List price: \$49. SIMMSaver Technology Inc., Wichita, KS; 800-636-7281, 316-264-2244; fax, 316-264-4445.

Circle 409 on reader service card
SIMMStack. List price: \$39. SerMax Corp., New York, NY; 800-209-7126, 212-410-1597; fax, 212-410-0452.

Circle 408 on reader service card
SIMMVerter. List price: \$25. Cameleon Technology Inc., San Jose, CA; 800-440-7466.

Circle 407 on reader service card



OLD FOR NEW: DRAM adapters such as the SIMMVerter (left), SIMMSaver (center), and SIMMStack (right) let you reuse old memory.

necessarily. A variety of new SIMM adapters let you use your 30-pin SIMMs in a motherboard designed for 72-pin SIMMs.

There are three main 30-to-72-pin adapters available: Cameleon Technology's \$25 SIMMVerter, SerMax's \$39 SIMMStack, and SIMMSaver Technology's \$49 SIMMSaver. These circuit boards let you plug your 30-pin SIMMs into 72-pin SIMM slots.

uses nonstandard clips that are harder to manipulate.

We used the adapters with 30-pin, 9-chip, 70-nanosecond (ns), 4MB SIMMs paired with a 70-ns 16MB SIMM on a Pentium/90 motherboard. All the converters worked well, and the results of our PC Magazine Labs' CPUmark₁₆ processor tests revealed no performance differences.

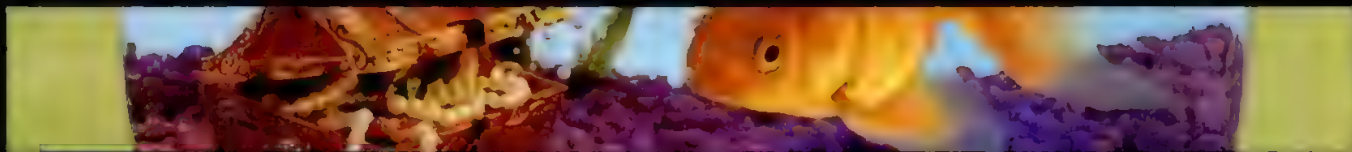
The adapters come in a dizzying



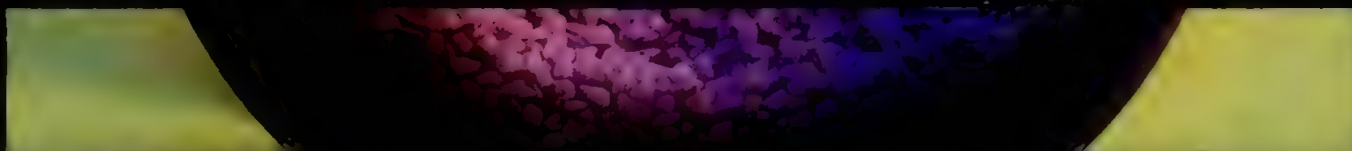
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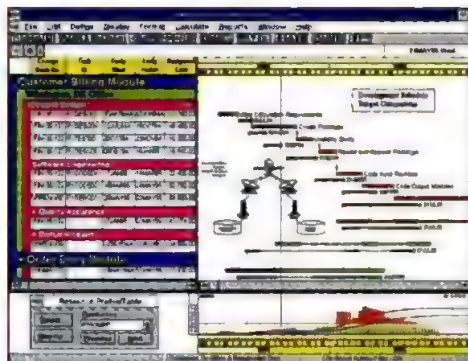
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New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Melissa J. Perenson

IBM's Value ThinkPads

IBM Corp. has introduced the successors to its value-line ThinkPad 360 series. The ThinkPad 365 series of notebooks, which starts at \$2,200 for the basic 365C, actually resembles the ThinkPad



CD-ROM TO GO: IBM's ThinkPad 365 CD features an internal double-speed CD-ROM drive.

755C in terms of performance and available features. The 5.8-pound 365C, which is made by Acer in Taiwan, comes standard with a DX4/75 CPU, 8MB of RAM, a 540MB hard disk, a 10.4-inch active-matrix screen, one Type III PC Card slot, a nickel hydride battery, and a single speaker. The 365 series improves on the design of the 360 line by adding an IrDA-compliant infrared port and a full-size keyboard that tilts for ergonomic comfort. The 365CD, which weighs 6.3 pounds and sells for \$4,000, includes an internal CD-ROM drive (the floppy disk drive is external) and microphone-in, line-in, and line-out jacks. **IBM ThinkPad 365.** Estimated street price: Starts at \$2,200. IBM Corp., Somers, NY; 800-426-2968, 919-517-1950; Web, <http://www.ibm.com>.

Circle 417 on reader service card

Packing a Pentium

Texas Instruments' TI TravelMate 5100/P90 packages a multimedia Pentium-powered notebook into a unit that may rival what's on your desktop. With a basic configuration starting at \$5,400, the TravelMate includes a 90-MHz Pentium CPU, 8MB of RAM, a 1.2GB hard disk, a Type III PC Card slot, an internal speaker and a 16-bit sound card, two lithium ion battery packs, and a 10.4-inch active-matrix display. There's also 2MB of VRAM to help boost your graphics color depth. **TI TravelMate 5100/P90.** Estimated street price: \$5,400. Texas Instruments Inc., Temple, TX; 800-848-3927; Web, <http://www.ti.com>.

Circle 418 on reader service card



It's a 3-D World After All

Are you ready for a new eye-catching, three-dimensional perspective but afraid of the learning curve that usually accompanies software that creates 3-D images? If so, look no further than **3D/Eye's** \$300 TriSpecives.

One of the first 32-bit 3-D modeling, illustration, and animation programs to come out for Microsoft Windows 95, TriSpecives provides real-time 3-D image rendering coupled with an intuitive drag-and-drop interface.

It's never been so easy to manipulate 3-D text, shapes, and objects; craft VRML virtual worlds; or create vivid animations of 3-D models. You can even mix 3-D models with 2-D text and drawings to create just one of the many visually enticing effects this software can produce. The program includes 250 scalable textures, colors, and surface finishes, as well as 50 templates to get you started in style. There's also support for OLE 2.0 and for 22 graphics file formats.

Applying object properties such as sizing, depth, color, and texture is a simple as dragging and dropping the selected property. Just as Visio has its SmartShapes, TriSpecives has Intelli-Shapes, a collection of 1,000 intelligent 3-D modeling shapes.

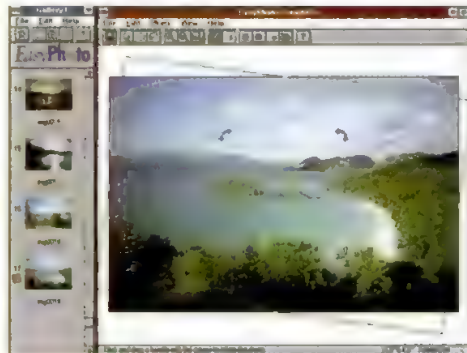
The \$500 Professional edition adds such useful features as SmartDimensions, a 3-D modeling feature that gives you accurate control over objects' alignment and positioning, and the ability to turn your 3-D illustrations into technical drawings that can be exported to any 2-D CAD or illustration program.

TriSpecives. Estimated street price: \$300. 3D/Eye, Ithaca, NY; 800-946-9533, 607-257-1381; fax, 607-257-7335

Circle 413 on reader service card

Easy Photo Fun

It's hard to imagine how **Storm Software** could have made the Easy Photo combination of photo scanner and software any easier to use, but it did. Easy Photo, Version 2.0, is great for keeping track of your photos; this is a remarkably powerful, yet extremely simple and uncomplicated, \$60 image editor. The photo reader features improved sensor technology and compliance with the Twain standard. The Easy Photo software has a new scanning algorithm so that images have higher contrast and better color balance. You now have the option of doing scans at optical resolutions up to 600 dots per inch (dpi) and enhanced resolutions of 1,200 dpi. Other software enhancements let you remove "red eye" and scratches from images and create slide shows, screen savers, and wallpaper with a single click.



VACATION MEMORIES: EasyPhoto, Version 2.0, makes it easy to alter your photographs.

There are also improved editing tools for rotating, resizing, and cropping images.

Easy Photo, Version 2.0. Estimated street price: Standalone, \$60; with Easy Photo Reader, \$250. Storm Software, Mountain View, CA; 800-275-5734, 415-691-6600; fax, 415-691-9825.

Circle 428 on reader service card

How to Break the CD-ROM Speed Limit

Here's a way to break the speed limit. **Ballad Synergy Corp.'s** \$89.95 CD-ROM acceleration software for Windows 95, d-Time 95, lets you take your CD-ROM to warp speed. d-Time 95 improves upon the interface and functionality of d-Time's previous DOS version. According to the company, d-Time 95 can boost a CD-ROM's performance by as much as 90 percent of your hard disk's speed. The increase depends on your PC's

New & Improved

processor, because the software takes key information off of multiple CD-ROM titles and stores it on your hard disk for quick recall.

d-Time 95. List price: \$89.95. *Ballard Synergy Corp., Silverdale, WA; 800-754-1204, 206-656-8070; fax, 206-656-8205.*

Circle 425 on reader service card

Innovative Pointers

Tired of using the same old mouse? **Gyratation's** \$149 GyroPoint Desk puts a new spin on pointing devices. GyroPoint Desk is a unique sleekly curved device that resembles a mouse and uses a miniature gyroscope to allow you to manipulate the cursor by freely moving the device in space with the flick of a wrist. Or you can use it on your desktop as though it were an ordinary mouse. In case you do presentations, then consider the \$399 GyroPoint Pro, which lets you wirelessly control the cursor from up to 75 feet away.

It must be something in the name: Just as the cartoon-cat namesake of **Altra's** \$70 alternative mouse, Felix, was known for his ability to outrun any mouse, so too can Felix the input device. Felix is ergonomically designed for both comfort and accuracy, with a one-inch-square surface area that makes controlling the cursor easy.

GyroPoint Desk. List price:

\$149. *Gyratation Inc., Saratoga, CA; 800-316-5432, 408-255-3016; fax, 408-255-9075.*

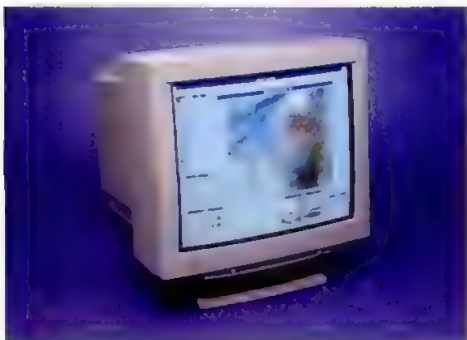
Circle 419 on reader service card

Felix. Estimated street price: \$70. *Altra, Rawlins, WY; 800-726-6153, 307-328-1342; fax, 307-328-1346.*

Circle 420 on reader service card

The Ultimate Colors

In case you're forever searching for the best-quality picture, **Hitachi America's** UltraColor CRT technology may be just the fix—for the moment. UltraColor technology is the driving force behind the vivid colors found in Hitachi's new \$2,465 Accuvue



ULTRACOLOR: Hitachi's Accuvue UX series of monitors takes CRT technology to a new level.

HARDWARE BRIEFS

Samsung Electronics America's DiskMaster Hard Drive Upgrade Kits bring the cost of a megabyte to less than 25 cents. The IDE drives are available with 850MB (\$239.99), 1.08GB (\$259.99), and 1.27GB (\$279.99) capacities. The drives have an average seek time of 11 milliseconds and they include everything you need to add them to your system. 800-726-7864, 201-229-4000.

CD-Recordable media just got a friendly boost in the arm. **Smart and Friendly** has broken the price barrier of using CD-R drives with its line of 6X recordable CD-ROM disks that sell for only \$7.99 each. 800-959-7001, 818-772-8001.

For an easy way to connect your computer to a TV, there's **TVview's** sleek and compact Presenter TVview. TVview is a \$449 adapter that lets you view Macintosh, PC, and laptop-generated output directly on NTSC televisions. 800-356-3940.

You no longer have to be at your office PC for simultaneous connectivity to both a fax modem and an Ethernet LAN. The **Epson LAN Fax 28NA** is a \$449 multifunction PC Card that's designed to operate with 10Base-T Ethernet and a 28.8-Kbps fax modem at the same time. 800-289-3776, extension 3,000.

Roland Corp. brings its Sound Canvas sound card to notebooks with the \$629 Sound Canvas PC Card SCP-55. There's support for General MIDI, Roland's GS format, Articulated-Wave technology for improved instrument realism, and a total of 538 on-board tones. 213-685-5141.

Keep your modem from getting fried with **Unlimited Systems' \$159** Konexx Connector Model 111. This portable device gives you an RJ-11 jack from a nonanalog phone, thus letting you connect your fax modem to the potentially destructive digital, PBX, multiline, or hotel telephones. 619-622-1400; fax, 619-550-7330.

ADPI's One for All RoadRunner is a \$995 SCSI device that's both a rewritable magneto-optical disk drive and a quad-speed CD-ROM reader in one. DOS, Windows, OS/2, Macintosh, and Unix drivers are available; a parallel port adapter costs \$150. 800-758-1041, 513-339-2241.

Panasonic's \$1,049 PanaSync C-1792P monitor features improved resolution and a 0.25-millimeter dot pitch. Well suited to the CAD/CAM environments, the monitor has 1,600-by-1,280 resolution and a 160-Hz scanning rate, which is optimal for viewing 3-D images with stereoscopic glasses. 800-742-8086.

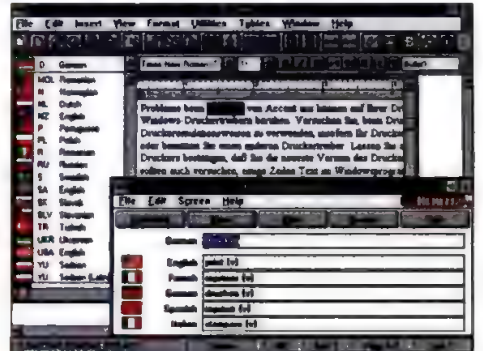
UX 4921 21-inch monitor. What's noteworthy about UltraColor is that, unlike Sony's Trinitron CRT, it uses an asymmetrical shadow-mask approach to improving the fineness of the dot pitch. Other components of the technology, including the use of larger phosphors for brighter colors on-screen, provide for high-contrast sharp images. **Accuvue UX 4921.** List price: \$2,465. *Hitachi America Ltd., Montvale, NJ; 800-259-9939, 201-573-0774.*

Circle 424 on reader service card

Multilingual Composers

If your work, education, or personal life has an international slant, chances are you could use a multilingual word processor.

Accent Software International's \$399 Accent Professional 2.0 builds on the earlier version with a number of improvements. Version 2.0 adds bidi-



ACCENT MARKS: Accent Professional 2.0 includes the Berlitz Interpreter.

rectional text entry to accommodate the addition of Arabic and Hebrew to its stable of over 30 languages, 70 fonts, expanded formatting, and rudimentary desktop publishing.

Other, less complete versions of Accent 2.0 are available starting at \$69; although these versions contain all 20 languages, advanced features such as multilingual spell-checkers and thesauri are missing. Accent Software has a product demo at <http://www.accentsoft.com>.

Universal Word 6.2a, from **Wysiwyg Corp.**, has over 100 language modules—including such languages as Bengali, Icelandic, and Welsh—available in 11 combinations at prices ranging from \$79 for a package with just English and Hebrew to the \$299 package with 52 Asian, European, and Semitic languages. Unlike with Accent 2.0, additional fonts are \$29, as are the supplementary dictionaries.

Accent Professional 2.0. List price: \$399. *Accent Software International Ltd., Exton, PA; 800-535-*

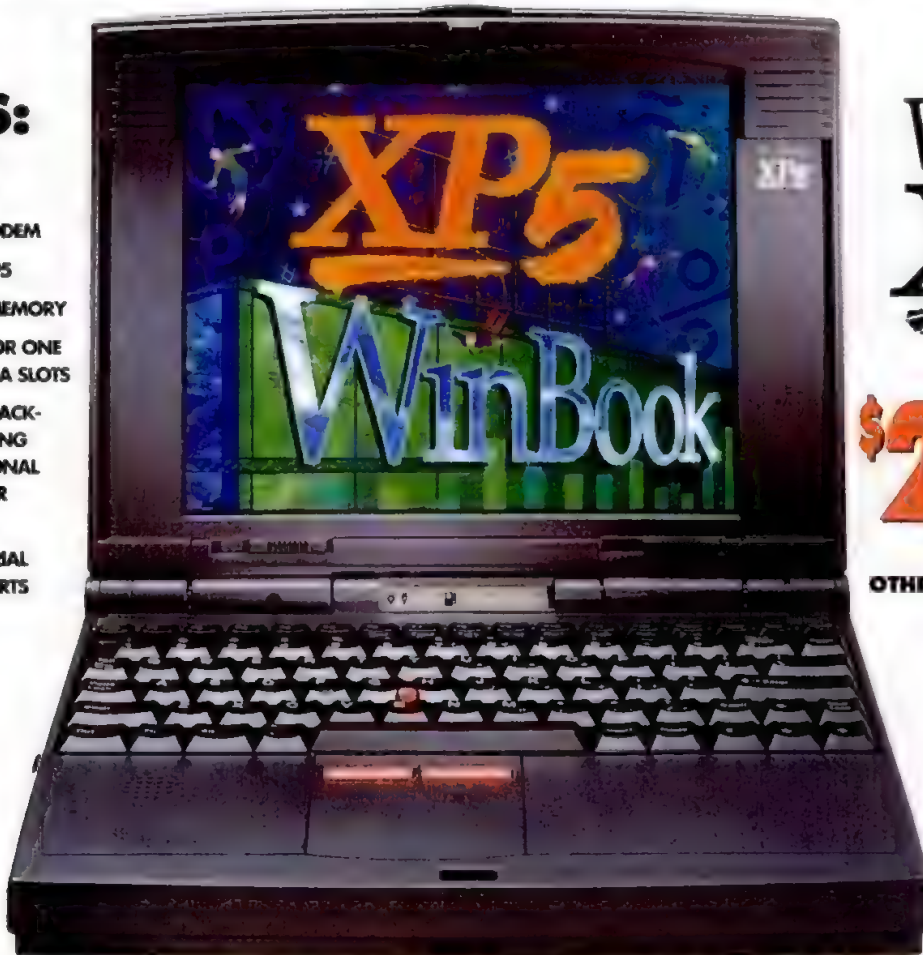
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You can download a trial version of Universal Word 6.2a from our ZD Net sites on CompuServe (type GO EDITOR for the Editorial Forum) and on the World-Wide Web at <http://www.pcmag.com/>.

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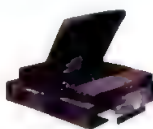
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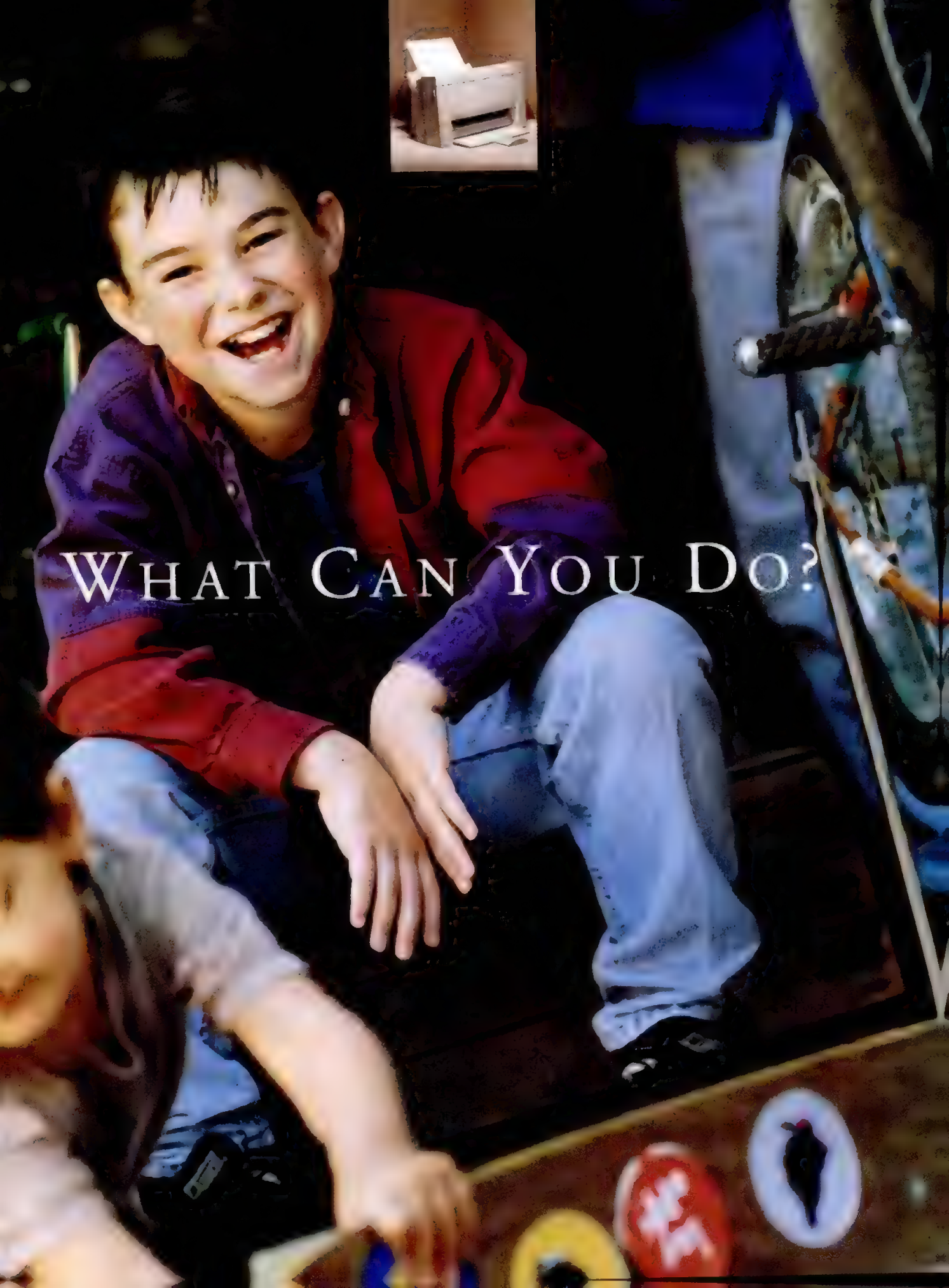
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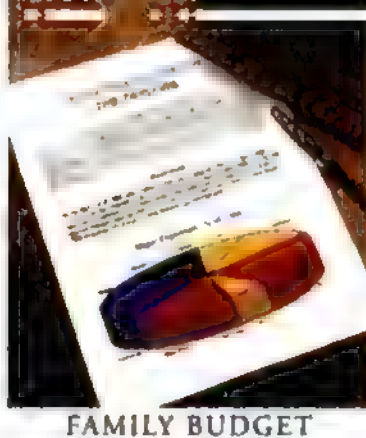
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Universal Word 6.2a. List price: \$299. Wysiwyg Corp., Los Angeles, CA; 800-489-9673, 310-575-1991; fax, 310-575-3141.

Circle 427 on reader service card

When Life Imitates Art

Forget about clunky monitors and CPU towers: The flat touch-sensitive consoles depicted in "Star Trek: The Next Generation" may be fewer generations away from your desk than you think. **Source Innovations'** Modula-Executive "Desk Pad" revolutionizes our concept of desktop computing. This \$3,500 French-designed device connects to your system (see Trends, "The Euro Desktop Crosses the Atlantic," October 11, 1994) and includes a 27- by 19-inch tablet that combines a 10-inch color active-matrix display, a keyboard,



FUTURE TOUCH: The Modula-Executive "Desk Pad" may be the next-generation console.

a mouse, stereo speakers, an infrared port, and a microphone into a flat half-inch-thick surface.

The membrane-touch keyboard is located in the upper half of the pad, while the monitor is directly below that. With these components on the same plane and axis, your visual angle is closer to your natural sphere of movement.

Modula-Executive "Desk Pad." List price: \$3,500. Source Innovations Inc., Long Beach, CA; 310-988-6574; fax, 310-427-8114.

Circle 421 on reader service card

Twofer Pointing Device

Now you really can have your cake and eat it, too: You no longer have to choose between your mouse and your touchpad—or even your mouse and your digitizing tablet—thanks to P.I.



TWO FOR ONE: WhyMouse.

Engineering's attractive alternative to buying an expansion card. The WhyMouse line of adapters consists of hardware port splitters that take a single port

and turn it into two ports for use with input devices. No additional software is required. The \$39.95 serial mouse and PS/2 mouse versions give

SOFTWARE BRIEFS

The \$59.95 Day-Timer Organizer 2.0, a cross-platform PIM from **Day-Timer Technologies** whose layout complements the paper-based Day-Timer organizers, has improved its network and work-group capabilities. Also included are TAPI and TSAPI telephony support, the ability to enter up to four e-mail addresses, and more powerful searching ability. 415-572-6260.

Road warriors on the go should love **AI Tech International's** Road Warrior Presenter. The \$499 bundle contains AI Tech's VGA-to-TV-scan converter, Multi-pro CTV; Interlink Electronics' wireless pointer, Remote Point; Gold Disk's multimedia presentation software, Astound 2.0; and Target Software's PIM, Appointments Plus. 800-882-8184, 510-226-8960.

Novell's \$189 WordPerfect 3.5 for the Macintosh and Power Macintosh features extensive, integrated Internet support. WordPerfect 3.5—which includes Netscape Navigator, a World-Wide Web browser—lets you create HTML documents from within the word processor. There's also support for text-to-speech using MacinTalk, dynamically linked bookmarks, and automated formatting. 800-453-1267, 801-429-7000.

Unsure if Microsoft Windows 95 is right for you? **Smart Systems'** Safeboot 95 is a \$29.95 utility that lets you install Windows 95 while retaining your existing Windows 3.1 configuration files. You're given a choice of which operating system to load each time you restart your computer. 219-838-3000.

The \$10 Mosaic In A Box for Windows 95, from **CompuServe Internet Division**, includes both 16- and 32-bit versions of the World-Wide Web browser. Also added is support for selected HTML 3.0 extensions, improved security, an electronic wallet for safe transactions, disk caching, and compatibility with VRML. 800-557-9614.

Arcland's \$195 Flow-Model 2.0 for Windows 95 is a 32-bit application that automates the process of creating detailed flowcharts and business diagrams. This version adds OLE 2.0 support, improved export features, and better special effects for text. 800-276-9945, 610-993-9904.

Rhinotek has new standard and home editions of its communications software, RhinoCom 1.5 for OS/2. The \$199 standard edition has added such features as automated script learning while the \$99 home edition, which uses the same engine, retains many of the standard edition's features. 800-234-4546.

you two ports for the price of one. The WhyMouse DigiDapter lets you use a graphics-digitizing tablet and a mouse off the same serial port.

WhyMouse. List price: Starts at \$39.95. P.I. Engineering Inc., Williamston, MI; 800-628-3185, 517-655-5523; fax, 517-655-4926.

Circle 422 on reader service card

Pentiums Head for Home

Pentium power for the home is becoming more of a requirement than an option. **Compaq Computer Corp.** and **Micron Electronics** have each updated their consumer systems for those who don't want to sacrifice power for ease of use.

Compaq's Presario 5500 Series is the latest version of its all-in-one monitor-and-CPU combination. Prices start at \$1,999 for a system with an integrated Super VGA monitor, hi-fi speakers, integrated 16-bit sound, a 1GB hard disk, 8MB of RAM, a quad-speed CD-ROM, and a 75-MHz Pentium processor (faster CPUs are also available). These units include SpeechMail voice-recognition technology for remotely retrieving voice mail messages and Compaq's TrueQ Sound and Motion, which is a combination of hardware-based MPEG video support, 3-D Spatializer surround sound, and optional wavetable-synthesis sound.



POWER FOR THE HOME: Micron's P133 Pentium mini-tower is not your average home machine.

Micron has set its sights squarely on the home market with its \$3,398 P133 Home MPC PRO system. The system has the same motherboard as Micron's Millennia line but includes an internal 14.4-Kbps telephony fax modem from ProMedia and a robust software bundle that covers both home and small-office users. The 133-MHz system also includes 16MB of RAM, a 1.2GB hard disk, a quad-speed CD-ROM, 2MB of DRAM, a 16-bit sound card, and a 17-inch monitor as standard equipment.

Compaq Presario 5500 Series. List price: Starts at \$1,999. Compaq Computer Corp., Houston, TX; 800-345-1518; Web, <http://www.compaq.com>.

Circle 429 on reader service card

Micron P133 Home MPC PRO. List price: Starts at \$3,398. Micron Electronics Inc., Nampa, ID; 800-388-6334, 208-463-3434; fax, 208-463-3424.

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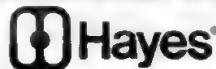
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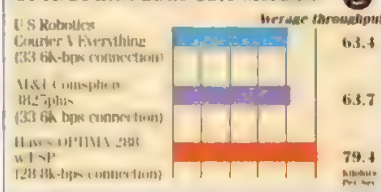
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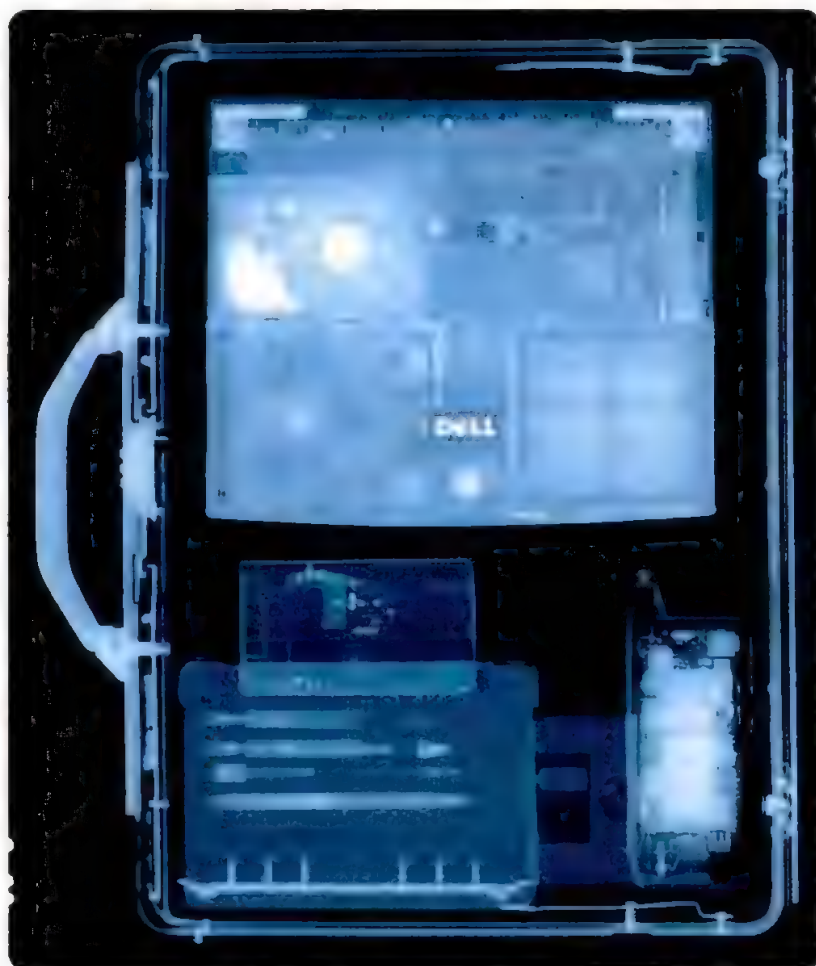
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Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Tin Albano

Getting Deeper and Deeper Into Microsoft Windows 95

BY EDWARD MENDELSON

If you want to change Windows 95's new interface and file system so that the generic "My Computer" feels more like your own computer, the one indispensable guide is Brian Livingston and Davis Straub's *Windows 95 Secrets*.

Unlike most Windows books, this one doesn't make you pay for a rewrite of Microsoft's help files. Instead it reveals undocumented and underdocumented techniques for changing almost anything in the Windows environment. Some of the simpler tips tell you how to customize the list of SendTo and New... items on the right-click menu. Others give you the details you need to use the new wildcard options in Explorer and explain that hotkey choices only work for shortcuts that you place on the Start menu.

The best tips—including the ones you won't learn from Microsoft—send you to the Registry Editor to add or modify entries. This isn't a job for the fainthearted, but if you have the courage, you can stop Windows' distracting and time-wasting habit of making application windows jump visibly from the taskbar to the screen and back again. You can add the Control Panel, Dial-Up Networking, and Printers to your Start menu. Best of all, you can change Windows' annoying habit of putting a tilde and the numeral 1 in the old-style 8.3 filenames that it auto-

matically creates when you use a new-style long filename.

Livingston and Straub explore the depths of the Windows memory management and DOS support. They even tell you when to ignore the advice you get from Windows itself. When Windows displays an error message telling you to increase the Files setting in CONFIG.SYS, they tell you to make a change in SYSTEM.INI instead.

Like most Windows books, *Windows 95 Secrets* comes with a CD-ROM of shareware and freeware, most of it worthless, but Livingston and Straub one-up the competition by providing a one-stop installation program for virtually all the programs on the disk. If you don't like the one you just installed, you don't even have to restart the installer to try the next.

More detailed books exposing undocumented Windows features will appear over the next few months, but, for now, *Windows 95 Secrets* towers over the competition. It obviously was rushed into print, and suffers from dozens of misprints, but the basic information is highly reliable. If you buy only one Windows book this year,



Friendlier Short Filenames

When you create a long filename like "LongFileName.txt," Windows also creates a short filename alias in the form "longfi~1.txt." If you would prefer an alias in the form "longfile.txt," *Windows 95 Secrets* tells how to get them. Run REGEDIT, then do the following:

- Click the plus sign to the left of HKEY_LOCAL_MACHINE. Continue clicking the plus sign next to System, and then CurrentControlSet, and finally Control.
- Highlight FileSystem.
- Right-click the right pane of the Registry editor. Click New and then Binary value.
- Type in the value name NameNumericTail. Press Enter.
- Double-click NameNumericTail. Type 0 as the single entry for binary value. Click OK.
- Reboot your computer.

make it this one.

Of the books that guide you through Windows 95 without revealing any undocumented secrets, one of the deepest and most accurate is *Inside Windows 95*, by Jim Boyce and others. This is a detailed tour of the operating system and its underlying principles, from its file system to its memory management. It explores the inner workings of the Registry but doesn't suggest any risky changes. When treating a complex feature-like networking, it always explains the basic theories of the feature before it introduces the practice of managing it.

Typical pages describe the more obscure options in the prop-

erty pages that define Windows' handling of DOS sessions, or list all the options of obscure Windows utilities like the one that backs up and restores long file names. The details are accurate, but the book misses a few useful

shortcuts. For example, if you use OS/2 Boot Manager, the book follows the Microsoft line that you have to use OS/2 boot diskettes to restore Boot Manager after installing Windows. In fact, you can restore Boot Manager by running Windows 95's own FDISK.

Other general surveys of Windows 95 are long on fluff and short on useful content. *Inside Windows 95* packs an enormous range of detail into a well-written, well-organized package.

Windows 95 Secrets, by Brian Livingston and Davis Straub, \$39.99. IDG Books, 1-800-762-2974; ISBN: 1-56884-453-0.

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Inside Windows 95, by Jim Boyce et al., \$40. New Riders Publishing, 1-800-653-6156; ISBN: 1-56205-375-2.

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READ ONLY RECOMMENDS



Are you just looking to cover the basics? Then Simon Collin's *The Way Microsoft Windows 95 Works* is the perfect guide for you. The book is packed with full-color Windows 95 screen shots and it will hold your hand as you take your first baby steps through Microsoft's new operating system. \$19.95; Microsoft Press, 800-677-7377; ISBN: 1-55615-680-4.

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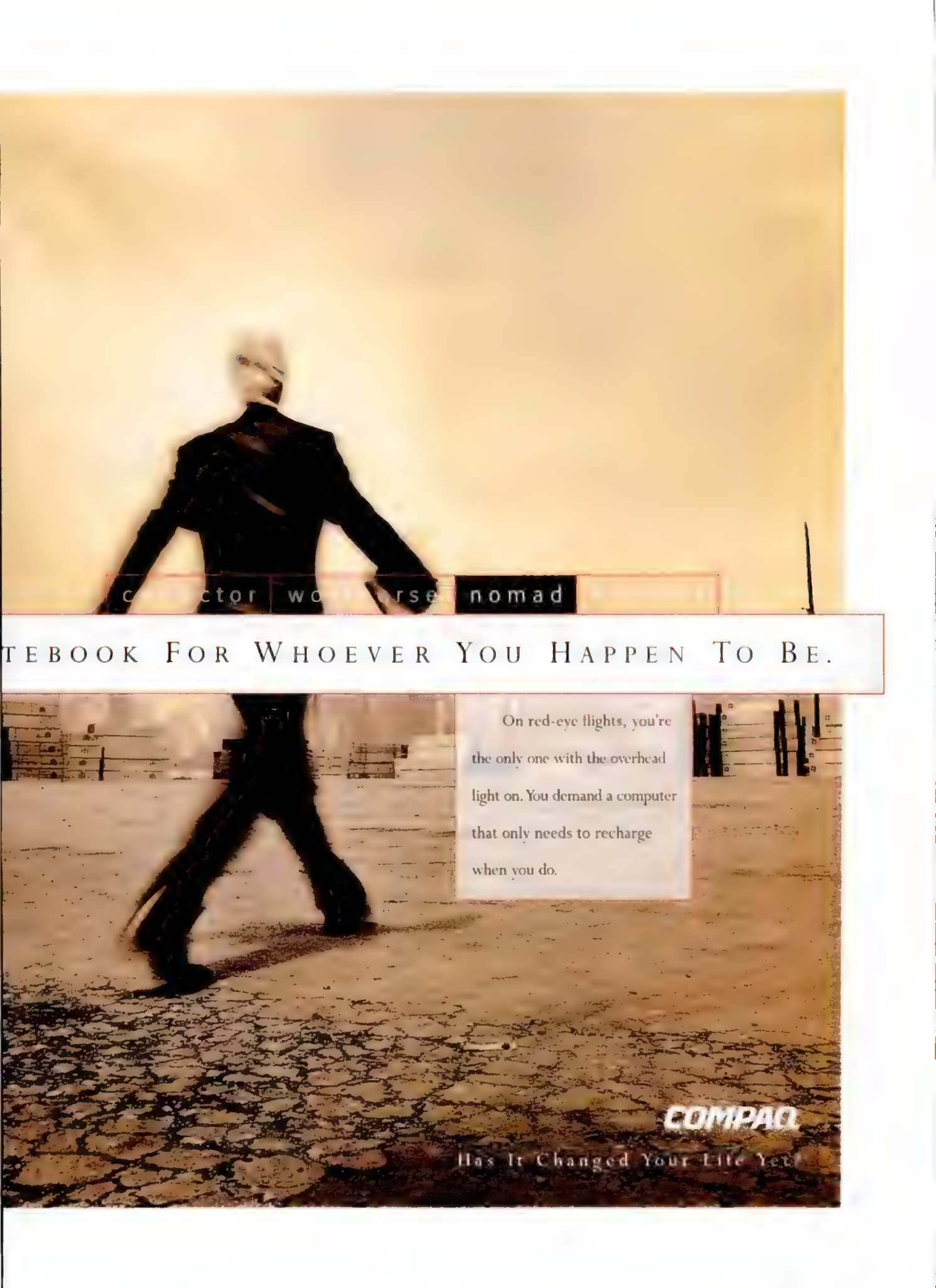
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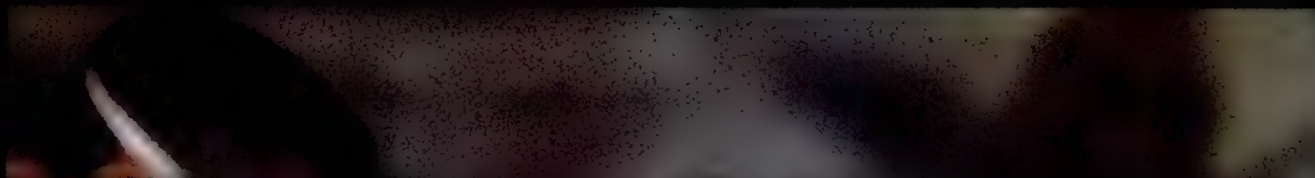
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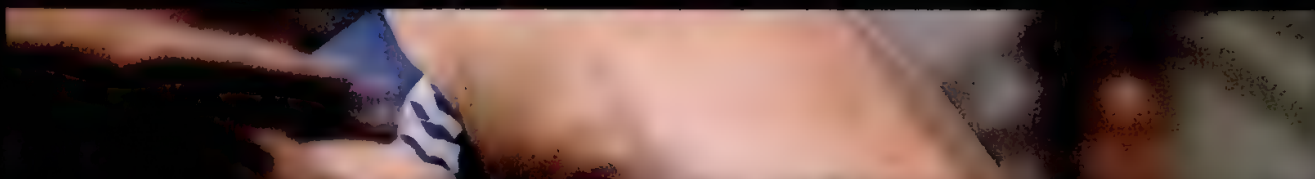
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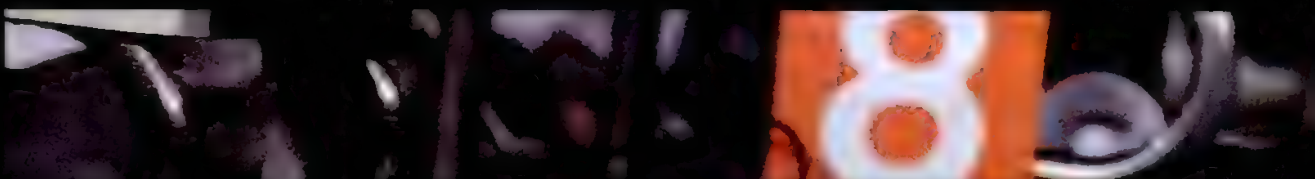
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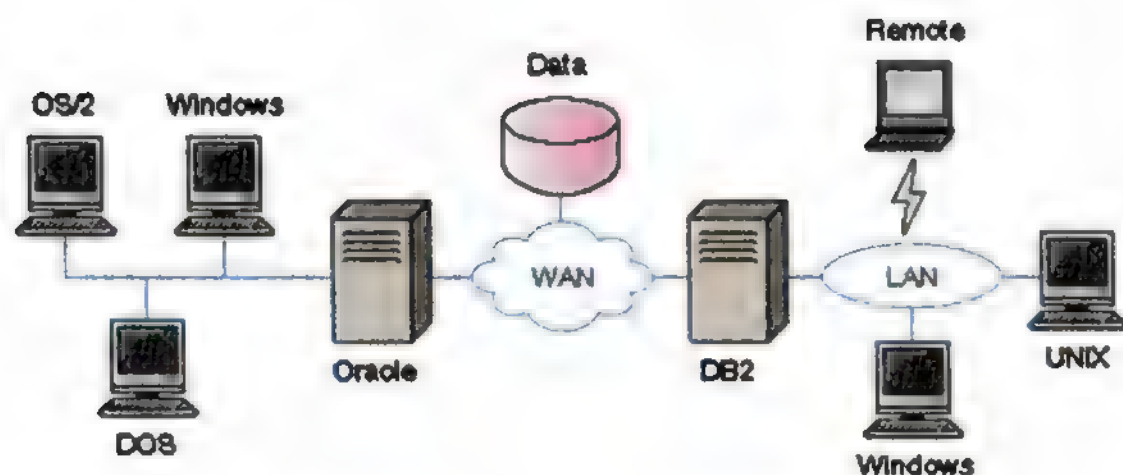


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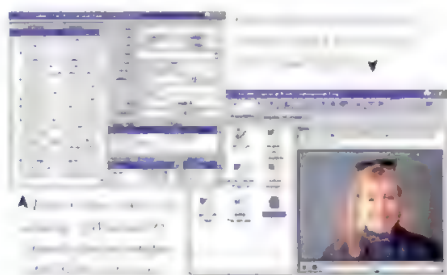


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CIRCLE 383 ON READER SERVICE CARD



Michael J. Miller

Is the PC Irrelevant?

As we move deeper into the Age of the Internet and our communications horizons broaden, we will have to rethink our notion of the personal computer. More directly, is our original concept of the PC dead? In some parts of the industry the re-

definition of the personal computer has already begun to take shape. At the heart of networked computing, for example, lies this question: What is more important, megahertz or bandwidth?

THIN IS IN

When we think of a PC today, we think of a machine that has a lot of processing capability, a complex operating system with powerful applications, and lots of memory and hard disk space. (By the way, calling this processing power "megahertz" is somewhat misleading, as that term really only describes a CPU's underlying clock speed, not its processing capabilities). In the parlance of network computing, today's PC is a "thick" client.

In comparison, today's servers are "thin," with only a limited array of features. Most servers simply perform "dumb" tasks such as file management and print sharing. A few application servers are appearing, but they remain rarities used mainly for corporate databases or applications like Lotus Notes.

Now, as the Internet spins its web over more people and every computer is connected to every other machine and every network connected to other networks, we're moving to an environment that calls for thick servers. These servers would not only store data but also provide for many other services including everything from security to transaction processing. You may be able to run scripts and applications on the server itself.

In this world, do we need powerful PCs? Won't increased bandwidth and a thin network client do?

After a recent speech, I was asked "Does the move to the Internet mean I'll never have to upgrade my PC again?" The meaning

behind this question is: If all of this power is readily available on the Internet, no one should need a faster or more powerful machine. Besides, won't it be easier on users if all the upgrades are done at the server and not on the client?

Already there are people in the industry arguing for more functionality on servers. Networks should be providing a lot more functionality as the Internet becomes the new computing platform. Someday soon the Internet will provide for secure, mission-critical, performance-oriented business processing. And yes, upgrading servers is far easier than upgrading your applications or your operating system or your personal PC. This is particularly true in large corporations where servers are connected to many workstations or in on-line services with servers connected to clients across the country or around the world.

THE SACRIFICES OF BEING THIN

I believe there is plenty of room for the sub-\$1,000 (eventually sub-\$500) machine that has a basic processor (say a 486), just enough memory, a browser, and a network connection. Given a thick server, such a PC would be the thin client of the future.

Companies like Compaq and Sun Microsystems are already steering towards thin clients (see this issue's Trends section). Compaq seems to be targeting a low-end Windows 95 machine primarily for consumers in overseas markets, and Sun is talking about the use of such a machine (running a browser and Java) in the U.S.

Thin clients supported by thick servers sound appealing, but I don't believe thin clients are the machines most of us would choose as our primary PC.

Why? Because as nice as



*Does the rapid development
of the Internet mean the
depersonalization of the PC?*

Michael J. Miller

it sounds, for most of us a thin client would be a step backward, toward the days of mainframes and central control. The computer industry's theme for the past decade or so has been "More power to the personal computer."

If we've learned anything from the PC revolution, it's that people want the ability to have control over their own machines. Even today's network workstation is a far cry from the terminals in the mainframe era. In those days, the typical user had no control over his or her applications. Today, most business users simply expect higher levels of control. This is one reason why so many businesses put applications on individual PCs instead of a central server.

People also want information immediately, and while I do believe network connection speeds will improve, we're still a long way off from having network connections that are anywhere near as fast as data coming off a hard disk. Right now, if you're lucky, you have an Ethernet, Fast Ethernet, or even

a T1 connection at your office, but these luxuries don't come cheap. At home, you're more likely to have a 14.4 or 28.8 bps modem. ISDN and cable modems are still extreme rarities. This will all change over time. Meanwhile, the latest hard disks can deliver data at speeds greater than 16MB per second.

The need to gather data quickly is more imperative if you want the ability to do things like create and display great graphics, multimedia, and video on your PC. While all of this can be—and in some cases is—delivered over the Net, the assembly and playback of the material is still dependent on the speed of the local PC.

KEEPING THINGS PERSONAL

The new push toward component architecture, cross-application scripting languages, and built-in "experts" requires that PCs become more personal, not less so. We don't need features or capabilities for their own sake, we need them because we want to make computers easier and more useful. Customization is going to be a lot more likely to happen on machines with plenty of processing power.

This doesn't mean we don't want a lot

more processing going on at the server level as well. Of course we do. I want my own "intelligent agents" on the server looking for information that is of interest to me. I want multimedia features and even video that I can download easily. I want high-speed connections. But I'm not going to give up my personal PC to get it.

Every few years we get into a debate between centralized computing and decentralized computing. When we relied on mainframes and dumb terminals, all the computing power was centralized. When the PC started popping up in homes and offices, the bulk of the power was transferred to the desktop, and we had dumb servers instead. With the move to client-server computing, we have started to see the power shared between workstations and servers on a much more equitable basis.

As we cross the threshold into a new era of computing—the age of the Internet—what we need are enhanced machines with a lot more capabilities on both sides of the line. In short, we'll need both megahertz and bandwidth, both thick servers and thick clients. And remember what end this bilateral development serves: to make us all more powerful. □

GUIDE TO ELECTRONIC EDITIONS

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If you're reading this before November 13, 1995, you can join the awards ceremony live on that date at 8 pm Pacific Standard Time (the ceremony is held at Comdex in Las Vegas, NV). After this date, you can visit the award site until September 1, 1996.

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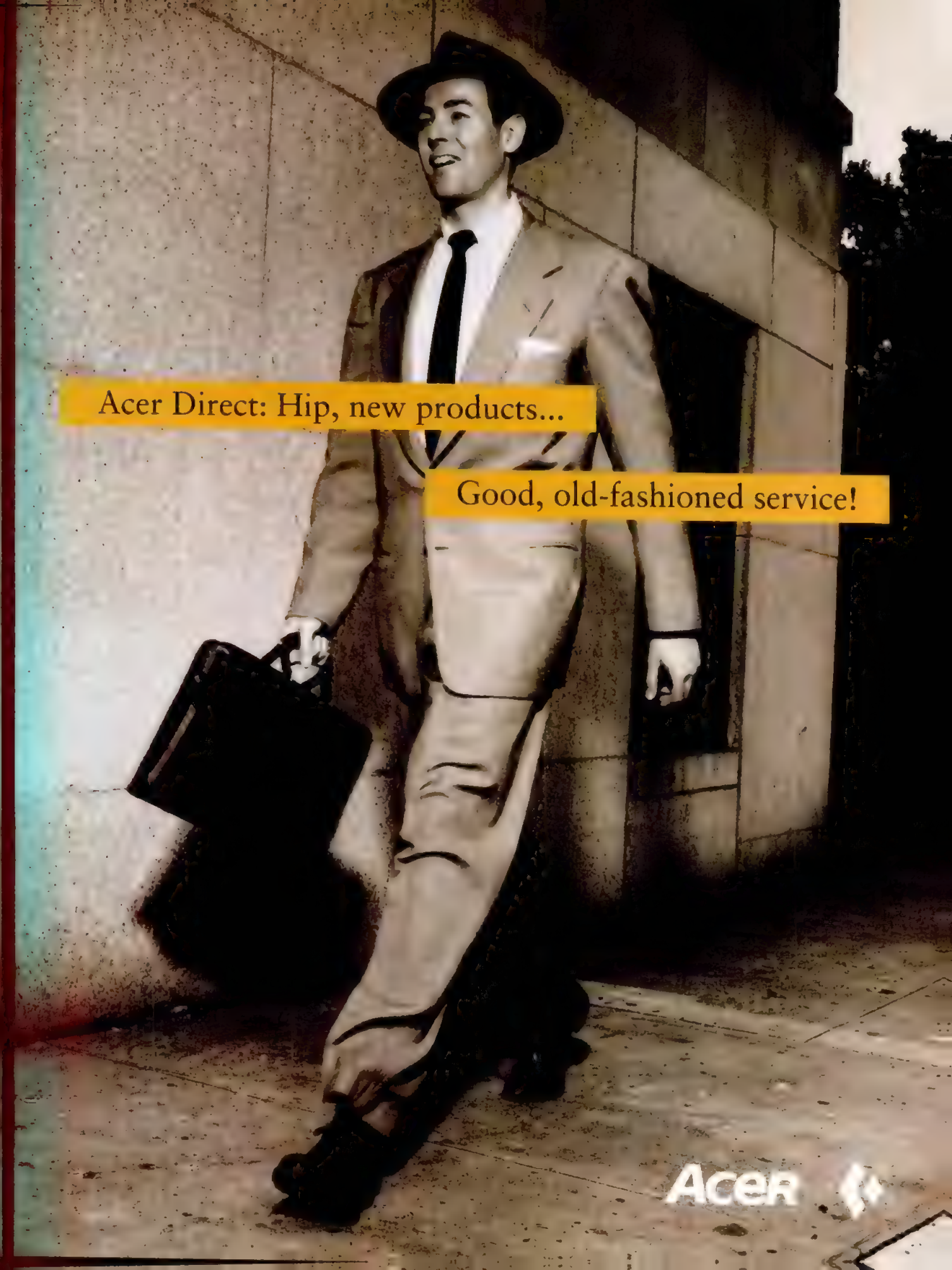
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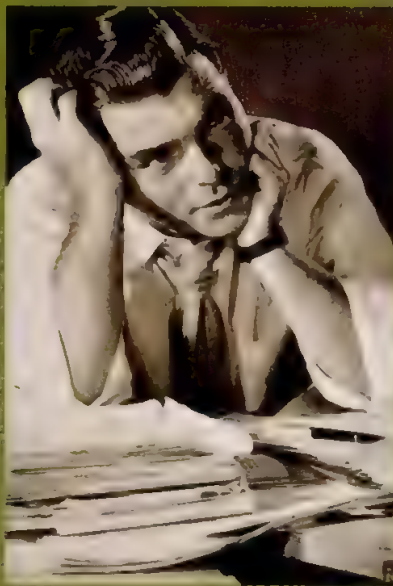
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CIRCLE 046 ON READER SERVICE CARD





Bill Machrone

What Use Is the World-Wide Web?

We used to have a division called Interchange. It was an on-line service and a publishing platform. It had a sophisticated user interface and was an excellent environment for both searching and browsing. It could present rich graphics reasonably well.

The first Web browser I ever saw had a clunky interface, half-baked navigation tools, and ugly graphics. I immediately knew that Interchange didn't stand a chance against it.

We don't own Interchange anymore (AT&T does). The whole idea was to build a publishing platform vastly superior to those of the major on-line services and attract publishing partners such as magazines, newspapers, and businesses. I don't follow Interchange's fortunes, even though we have an agreement to put our content on it. The World-Wide Web has become the hot place to be.

The Web has many virtues, not the least of which is self-determinism. You get to decide what your site looks like, how many pages it comprises, what kind of search capability you'll offer. The Web's underlying language, HTML, is an admittedly limited publishing platform, but the forced simplicity increases its accessibility. You have to be creative to make your pages stand out, but a quick perusal of the Web shows that it's being done every day.

Some say the Web is part of a fundamental societal shift, a democratization of publishing that gives everyone equal access. Others say it's just a fad. Just like the people who went too far by writing payroll programs in Lotus 1-2-3 macro language, people are in danger of making the Web do too much.

Despite all the hype, it's ill-suited to some applications, such as interactive games. The Web also needs major help doing high-content pages; fortunately, the architecture allows for helper apps, such as Adobe Acrobat and Common Ground, to render and print high-resolution pages. Reading the Acrobat version of *PC Magazine* on the Web (www.zdnet.com/~pcmag) is hardly any different than reading it at home or in the store. A more meaningful

example: A little company like Parallax (www.parallax-inc.com) using Acrobat to publish information on its innovative BASIC-programmable microcontrollers. The Web gives customers instant gratification and lets Parallax publish electronically at print-quality levels.

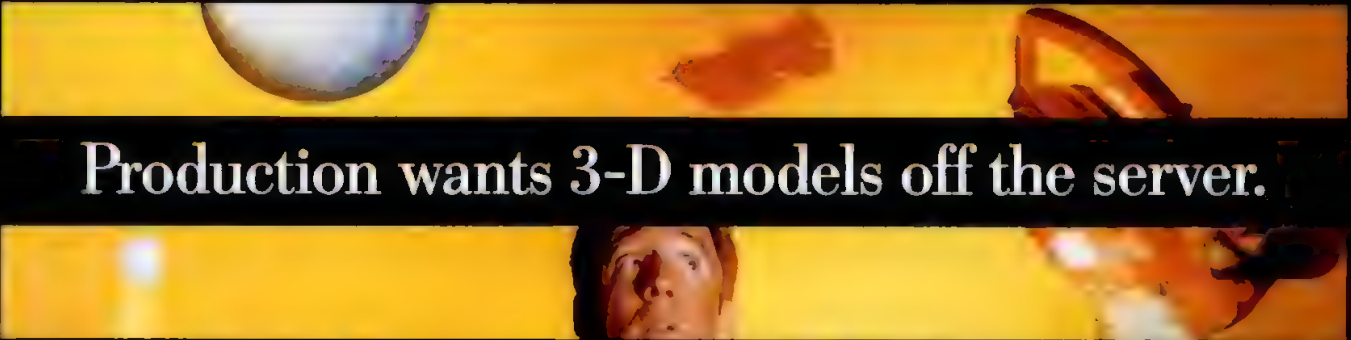
I'm suspicious of the claims of big societal changes, too. The Web is not doing a particularly good job of reaching out to the poor and disadvantaged. Aside from a few notable community projects, the Web is the dominion of people who are already adept at manipulating information. The idea of a new democracy based on electronic pluralism and virtual town meetings is so far from reality that it's laughable. Today's version of electronic "democracy" remains more of a threat than a promise.

The typewriter, the mimeograph machine, the photocopier, and desktop publishing were all tools of democratization, too, extolled by many, and condemned in totalitarian societies. Yet very few people use these tools to publish personal newsletters and magazines. Likewise, few individuals avail themselves of the federally mandated public-access channels on cable TV. Publishing remains in the hands of the people who own or can afford the distribution channels—or who are crazy enough to toil at it as we do here.

Except for the Web. Businesses go onto the Web to tout their products and provide access channels for their customers. They hire editors and art directors to make their sites attractive. But far more intriguing is the tremendous upsurge in personal pages. No professional editors and artists here, just people with a strong desire to publish their own views of the world and themselves. The Web is a magnificent experiment in communications, and personal pages are a new form of expression within that experiment. □



The idea of a new democracy based on electronic pluralism is so far from reality that it's laughable.



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Second Looks

LIVING WITH THE PRODUCTS WE REVIEW

All That Glitters: Gold SIMMs Lose Their Shine

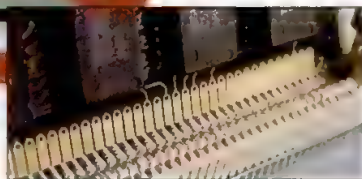
Readers have begun to report an insidious problem with their in-line memory modules: corrosion caused by incompatibilities between the gold plating on the SIMMs and the sockets on the motherboard.

Within the past two years, most manufacturers have switched from gold-plated sockets to tinned sockets, in the quest for ever-lower prices. The tinned sockets require matching SIMMs with tinned edges. Installing SIMMs with gold contacts into tinned sockets causes no immediately apparent problems but sets the stage for corrosion that will eventually destroy the socket.

This is no small problem: A dead memory socket is as good as a dead motherboard. Installing newer, tinned SIMMs into an older

machine with gold-plated sockets is also a recipe for disaster. High-humidity conditions make the corrosion worse.

If you're planning to add more memory, check your sockets (and your existing SIMMs) before ordering more chips. The gold plating is easily visible as thin gold lines in the bottom of the socket or as gold fingers on the bottom of SIMMs: tinned sockets have silvery gray lines. If you find that you have gold SIMMs factory-installed in



Be sure not to install gold-plated SIMMs into tinned sockets. The combination is corrosive.

Zapped by Zip Drive?

You finally found one of Iomega's wonderful Zip Drives and half a dozen of its oh-so-rare 100MB floppy disks. Lucky you. Now you upgrade to Windows 95 and find that your ZipTools utilities no longer work. Download the new version? Don't be silly! Iomega has been charging customers \$29.95—plus postage—for the "upgrade," even though the Win 95 utilities will be bundled for free with the new Zip drives by the end of November. Iomega will, however, send a \$30 rebate to registered users.—BM

tinned sockets, call your factory service rep and hope for the best.

In all likelihood, relatively few machines were built this way, but if you've got one, it's an accident waiting to happen. If you've installed the wrong SIMMs yourself, you've probably voided your warranty. (Remember to ground yourself to the machine before adding or removing memory to prevent damage to the PC or injury to yourself from static electricity.)—BM

New Core for Apple Color Laser Printer

There's nothing more frustrating than buying a new peripheral and hooking it up to your PC only to find it won't work. When we first reviewed the Apple Color Laser Printer 12/600 PS (First Looks, September 12, 1995) we noted an incompatibility between the printer's driver and

PCs with a Phoenix BIOS. As it turns out, the driver incompatibility has more to do with the speed of the CPU than the BIOS the system uses. We discovered that the Apple Color Laser Printer 12/600 PS won't work correctly with many 90-MHz and faster Pentium PCs.

The engineers at Apple have written a new driver for Apple Color Laser Printer 12/600 PS that solves the system incompatibilities that occur with 90-MHz and faster Pentiums. If you've experienced problems with your 12/600 PS, stop by Apple's forums on eWorld and CompuServe and download the new printer driver. You can also get



the driver from Apple's Web site (www.apple.com). The file you want to retrieve is Color Laser-Writer for Windows 1.1.—TA

Fix for Netscape Bug

Who knows what weird and wonderful bugs will have crept into and out of Netscape Navigator by the time you read this. Version 1.22 has a nasty habit of erasing all your TrueType fonts or just rendering them invisible to Windows. One reader solved the problem by simply marking all the fonts read-only. It works.—BM

How to contact Second Looks: On ZD Net type GO ZNT:EDITOR, and choose Views: Machrone. Contact Machrone directly via MCI Mail at Wmachrone or CompuServe at 72241,15. You can also find us on the World-Wide Web at <http://www.ziff.com/~pcmag>.

LOOKING AHEAD

Tell me what you love and hate about these products and we'll share the information in future issues.

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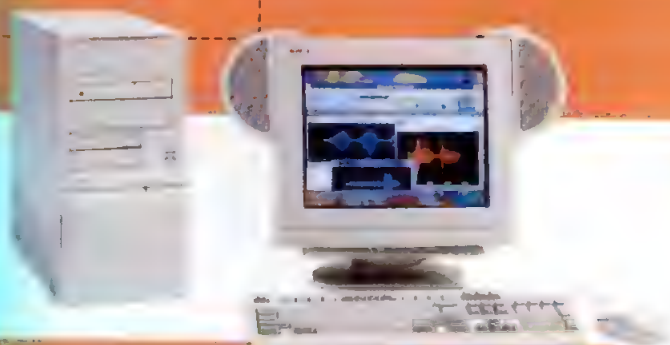
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John C. Dvorak

Color Copying for the Rest of Us

It's unusual for me to devote an entire column like this to one piece of equipment unless that piece of equipment is unique. The Hewlett-Packard CopyJet falls into that category and should be considered seriously by anyone with a home office,

although it also works well as a networked color copier/printer. The CopyJet, which can be had for a street price of around \$2,500, is essentially a color printer that doubles as a color copier. Using the HP DeskJet 1200C enhanced ink jet system as a starting point, the CopyJet is one of those products that you may have your doubts about until you see them work.

When I was first told that HP was going to do a color copier, I assumed it would be based on its color laser engine—not on an ink jet printer. But the color copies from this device are incredibly rich and sharp, and it's now obvious that the ink jet mechanism HP has perfected makes for the perfect color-copier mechanism.

If you examine the CopyJet closely, you'll see that it's essentially an HP DeskJet 1200C with a cleverly integrated ScanJet color scanner. The device is attractive but large, and at 77 pounds it's heavy, which I guess assures that it won't be easily stolen (or moved, for that matter).

This device forces me to make a confession regarding my misreading of ink jet technology. When the first ink jet devices showed up a decade ago, I thought it was an interesting technology that would probably be a cheap substitute for dot matrix devices. Dot matrix is an impact technology and has the advantage of being able to print multiple forms. So ink jet technology, which could only print a sheet at a time, would be ancillary to dot matrix printers.

Or so I thought. One thing is for certain: I never believed that ink jet devices would seriously compete with laser printers when it came to quality. But the HP DeskJet 1200C and various Canon and Epson printers showed that this weird technology (and, make no mistake, it is weird to shoot a charged droplet of ink onto paper while controlling its position with magnets), had

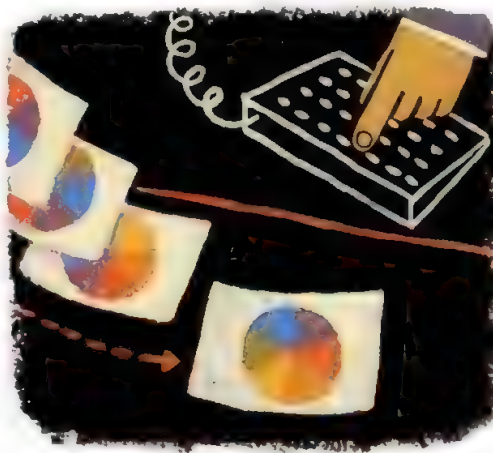
a lot more going for it than I ever imagined.

Only the HP engineers could have known the true potential of the ink jet mechanism that they honed. These engineers have recently pushed the state of the art even further with pigment-based inks. You'll find that the black cartridge in the four-color DeskJet 1600C employs this new ink. Until now everything has used water-soluble, dye-based inks. Eventually this will change. The new pigment-based ink produces a finer dot and is less prone to smear. The CopyJet currently uses traditional dye-based ink technology, which means the page will run if soaked in water. This is the only negative aspect to most ink jet devices. Even so, the CopyJet produces 300- by 300-dpi resolution in color and 600-by-300 resolution in monochrome, making it an excellent copier and printer.

While I've never been a fan of the idea that one device can be versatile enough to be a good copier and printer and scanner and fax machine, I'm in the minority. Today's SOHO user wants a combination product if for no other reason than to reduce the real estate requirements of separate devices. HP may as well add scanner and fax capability to the CopyJet mix.

I'd also like to see PostScript capability as well as an external hard disk to store the PostScript fonts. Such a setup is very common on the Mac, but too few PC users have discovered the power of an external dedicated hard disk hooked to their printer. Even so, the CopyJet is a very impressive product.

The problem I've had with ink jet technology over the years is that if the printer sits for a long time unused, the jets tend to get a bit clogged. With HP's new device this will never happen: You'll be using it constantly. Look for more ink jet-based copying machines from other vendors once they get a load of the CopyJet.



Only the HP engineers knew the true potential of the ink jet mechanism that they honed.



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Inside Track

W

hile Cyrix has been showing its newly named **Pentium clone** (calling it the 6x86), Intel has been continuing with its plot to take over the desktop market completely. Word from **deep inside Intel** has it that the company intends to go into the **laptop manufacturing** business later this year. Machines should be on the market shortly, probably with the names **Dell** and **Gateway** emblazoned, along with the now-ubiquitous Intel Inside sticker. It remains to be seen when Intel will bite the bullet and actually put its own name on the laptops or desktops.

According to my sources, Intel does have branded machines that it is **test-marketing quietly in Finland**. Would someone please send me a JPEG image of one? The Cyrix announcement of a clone chip will not stop Intel from eventually owning the entire desktop market, with Intel-brand computers appearing by the year 2000.

While on the Subject of Laptops Dept.: I recently upgraded my notebook computer from the Toshiba Portégé 3600 to the new Portégé 610CT. If you haven't noticed, I haven't been plugging too many laptops recently. Until now. This machine is a **phenomenal piece of gear**. Get this: 4.8 pounds, 9.5-inch active-matrix color screen, 720MB hard disk, 90-MHz Pentium, two PCMCIA slots, EDO memory, and **integrated Sound Blaster Pro** sound system. The color screen is the brightest, most **stunning** display imaginable. Killer. Good luck to Intel competing with Toshiba. Hey, Intel can always cut off Toshiba's supply of chips, eh?

Which brings me to a point of semantics: Exactly what is the difference between a **laptop** and a **notebook** computer these days? More and more, I tend to use the words interchangeably and see little difference.

Both are the size of a three-ring binder. One group of machines are in the 6.6-pound to 7.5-pound range and contain a floppy disk drive and maybe a CD-ROM nowadays. What many call notebooks are typified by the Toshiba 610CT. They weigh from 4 to 5 pounds and don't have a built-in floppy disk drive; instead, they have a lightweight external floppy disk drive that attaches to a floppy disk port. Smart users have chosen this type of machine to save the 2 pounds of extra weight (look at the size of a 2-pound roast and ask yourself if you want to lug it around when you travel). **Research** by the makers of laptops has indicated that the public still demands a built-in floppy disk drive, and not that many laptop users travel enough to be concerned about weight.

A point of semantics:

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My Plea: Then again, the laptop makers have done a poor job of marketing many of their wares, believe it or not. I was visiting NEC recently and was shown a **TV tuner that plugs into a laptop**. I'm thinking this is cool. While sitting around the airport I could be **watching TV on the laptop**. Then I find out that these devices have been around for a few years and nobody has bought them. I mentioned this to some IBMers, and they said, "Yeah, we did a tuner too. Nobody seemed to want it."

I'm reminded of a time in the late 70s, during the CP/M era of computing, when I was told that **nobody wanted colored floppy disks**—that's what studies showed. Nor apparently did anyone want or need

color monitors. Studies showed they were unimportant. I could go on and on about this with more examples of **lack of common sense** in this business. The laptop makers never considered the fact that their near-\$1,000 price tag for simple TV tuners may be why nobody wanted them. While you're at it, add an AM/FM tuner too.

April Fools Kinda Dept.: Apparently someone someplace posted on various IBM forums some fake upgrades to OS/2 in the form of a FixPack, dubbed Fix-Pack 11. What a unique form of guerrilla marketing.

While on the Subject of OS/2 Dept.: If you thought my column on IBM spinning the software division into a Lexmark-like operation was offbeat, here's a funnier concept from reader Barry Hart: "Please don't think OS/2 is dead. I have a good idea, although it doesn't sound that brainy: Make OS/2 shareware. I mean, IBM is practically giving OS/2 away to people. I have a friend who paid \$25 for it. With the BonusPak and all the other stuff IBM could sell separately, the company would make as much as it's making on OS/2. This would kill Win 95. I have over 2,000 shareware OS/2 programs. OS/2 will never die (at least not on my system)."

Gee, and once IBM sells enough shareware licenses, it will have enough money to become a real software company.

Here's Yet Another Study Dept.: Get this: Chilton Research has completed a study concerning on-line usage by teenagers. Guess what? The study indicated that more teens are using on-line services than in the past (duh), and they tend to use on-line systems to play games and do on-line chatting instead of hardcore research and information seeking. What a **shocking discovery**. I understand that future studies by Chilton will indicate that some lawyers are corrupt, government is inefficient, and milk **goes sour** if left unrefrigerated. Good work, boys.

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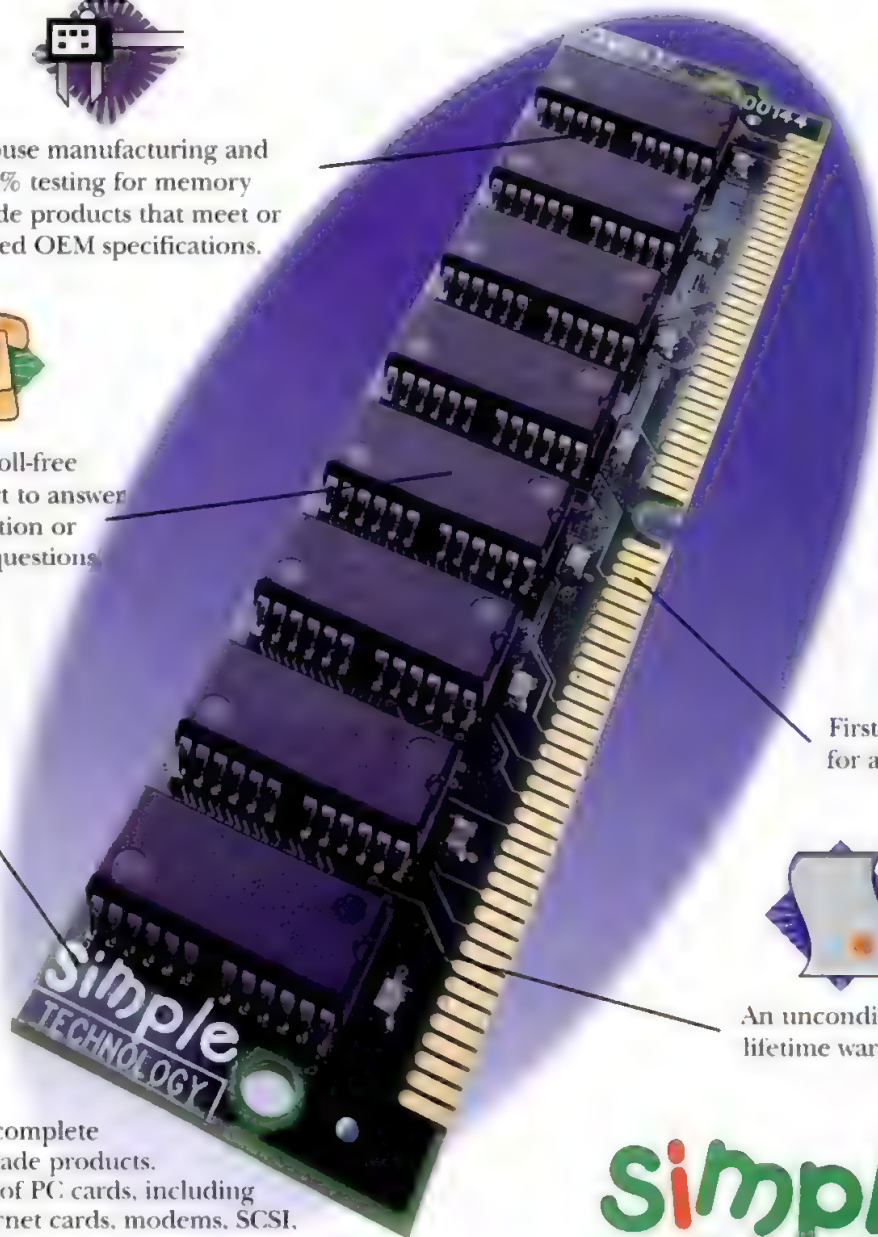
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Jim Seymour

Win 95: It's All in Your Perspective

It may be an old line, but it's still a good one: "Where you stand depends on where you sit." Almost always, our perspective arises from a combination of our own personal experiences and our current situation.

That "where you stand" line is my stock explanation this week at Fall Comdex for the wide gulf between reactions to Windows 95 I've found among most individual PC users I've spoken with and among many of the corporate IS people with whom I work.

Overwhelmingly, the individual users like and have begun to use Windows 95. Not nearly so overwhelmingly, but very significantly, corporate computing managers are cool to Windows 95. Even when they use Windows 95 on a personal PC.

A short while back, in our issue of November 7, 1995, I wrote a column about the Windows 95 Guerrillas—the people I like to refer to as "self-adopters" of Windows 95—who bring their personal copies of Windows 95 to work or buy and hide Windows 95 in their expense accounts as client lunches. This time, some thoughts from the other side.

While Windows 95 is certainly a hit by any standard and clearly has established a beachhead in U.S. corporations, it's also clear that the Windows 95 adoption rate in medium to large businesses has so far been a lot slower than Microsoft had expected. While admitting this to me privately, Microsoft's marketing people then invariably express shock that businesses are dragging their feet on adopting Windows 95.

"How could that be?" they wonder. "How is it that these IS people just don't get it?"

Often these little chats arise from a not-so-hidden agenda: Pump up Jim on what a self-evidently good idea rapid adoption of Windows 95 would be, and maybe he'll go out there and preach, "Adopt! Adopt! The Beginning is Here!" I can understand that—columnists tend to leave their B.S. Detectors set on high. But often enough, and especially in

conversations with people who have no vested interest in the success of Windows 95, I sense real puzzlement.

That puzzlement, both real and feigned, arises from a failure to understand how business manages its investment in computing. I wrote here last summer that it seemed obvious to me that The Year of Windows 95 was going to be 1996, not 1995 ("It's Not Just the DOS Gods," July 1994). This was before Windows 95 shipped, and it wasn't a criticism of the product. It was based on the three P's of corporate IS investments: planning, purchasing, and proliferating.

The software buying cycle in business, especially large businesses with many desktops, is surprisingly long. Most IS shops already have their purchasing plans and budgets in place through the calendar year 1996, for example. Once cast, those plans sometimes change in small ways, but rarely on a scale so large, expensive, and potentially disruptive as moving to a brand new client operating system.

Sure, Corporate America has known Windows 95 was coming for two or three years—but until midsummer 1995, IS shops didn't have a beta in hand that was sufficiently stable and final to begin making the go/no-go decision on migrating to Windows 95. Which meant that for them, a Windows 95 move was a 1996 move—at the earliest.

As individuals you and I can make quick decisions, choosing to bite the bullet on the cost of our hardware and software upgrades with relative ease. But people who manage fleets of PCs in the hundreds or thousands face a much bigger hurdle in deciding to spend \$2,000 to \$4,000—the figures most widely quoted—per PC to make the jump. A company with 2,500 PCs, of which perhaps 2,000 must be extensively upgraded for Windows 95, easily can face



The three P's of corporate IS investments: planning, purchasing, and proliferation.



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CIRCLE 080 ON READER SERVICE

Jim Seymour

a bill of \$10 million for the hardware and software for that migration. Factor in end-user training costs, Help Desk training and support, and management time, and that figure doubles.

No company I know of takes a \$10 million to \$20 million decision lightly. Especially when there are so many other costly moves afoot.

• Example: After dragging their feet on moving up from NetWare 2.x/3.x, business are finally moving to NetWare 4.x in droves—if not to Windows NT Advanced Server. Both paths are complicated and expensive and promise bigger returns than an upgrade to a new client OS.

• Example: With network bandwidth stretched thin almost everywhere in American business, improving net performance is a Very Big Issue indeed in most IS shops, whether they do so by adding switching, by segmenting, by pulling new and faster cables, by changing to 100MB-per-second Ethernet, or by buying ATM equipment and lines. All promise bigger returns than a new client OS.

• Example: By installing Lotus Notes or by adding multiple internal Web servers (the famous and growing "Intranet"), companies are pushing for better, faster communication among employees. It's an expensive but necessary step to staying competitive. Either way, it means bigger returns than a new client OS.

GO SLOW OR GET BURNED

In assessing why businesses are going slow on adopting Windows 95, too many people focus on issues such as resentment of Microsoft, distrust of any v. 1.0 product from Microsoft, minimum RAM requirements, skepticism about the value of GUIs, and other peripheral issues.

The biggest reason is much more far-reaching: They don't see the move as a good business decision. Right now, they have a workable client OS in place—usually Windows 3.1 or Windows for Workgroups 3.11, perhaps OS/2 Warp, or maybe DOS 5.x/6.x—and they have better places, with bigger, faster paybacks, to spend the money.

There's no mystery why individual PC users have been far faster moving to Windows 95 than have businesses. It's just that where you stand on the issue depends on where you sit. □



Bill Howard

Look, Ma! No Wires!

Any method of communication that doesn't involve a wire is going to be slow, unreliable, or expensive. Probably all three. That has been the rap on cellular data transmission for the longest time. But times have changed, and if cellular data isn't

quite perfect today, it's good enough that you can get some real work done.

By cellular data I mean connecting your notebook to an off-the-shelf cellular telephone, actually making a connection with one or two tries, and transmitting data at an acceptable pace (9,600 bits per second). I've been using cellular phones for data transfer for the past two years, and I find it now works somewhere between okay and good. That's not a ringing endorsement, but the fact that it works at all represents incredible progress for people who have to be able to send and receive data when they aren't near a land-line phone.

If you're interested in trying it, you'll need:

- A notebook computer with a PC Card slot.
- A cellular-ready PC Card modem. That means a modem that uses one of the cellular data protocols: ETC (Enhanced Throughput Cellular) from AT&T, MNP 10 or MNP 10EC (Enhanced Cellular) from Microcom, or the TX-CEL "spectral shaping" technology from Celeritas.
- A smart cable to link your modem and phone (\$40 to \$100).
- A data-ready cellular phone.

If you want the fewest hassles, buy everything from a single source. Then when it doesn't work, there's no finger pointing. If you want to assemble the pieces yourself, there are more than 40 phones with data capabilities, but I'd recommend you start with a basic, analog-only Motorola flip-phone. While Motorola phones have Mickey Mouse ergonomics, they're rugged, and every cellular modem vendor supports Motorola. Nokia, the number-two vendor, is a good second choice. By early 1996, I think the brand of phone will be less of an issue than it is today.

By dialing into data spe-

cific lines (precede the phone number with *3282, or *DATA), I've been able to make and hold cellular data connections in cars traveling at highway speeds and on commuter trains. On the train, if you hook up your cell phone, dial out, and 45 seconds later get that distinctive beep-BEEEEEP sound of two modems locked onto each other, heads snap around. Most people who know what the sound is can't believe it's happening.

To be clear, this is cellular data over the circuit-switched AMPS (American Mobile Phone System) analog network we're talking about. Although the data that flows across the airwaves is digital, you're not using a digital circuit. You may find that if you bought a fancy dual-mode analog/digital cellular phone, it may not be supported initially, not even on the analog half of the phone. (As a personal aside, I've found many digital voice connections sound as if you're talking underwater; the reason the cellular carriers like digital connections is that it allows more calls per cell.) Nor is this CDPD (Cellular Digital Packet Data), a cellular technology that requires a separate CDPD modem and seems best suited for very short bursts of data. The ideal CDPD app would be for a roving kiosk that needs to verify credit card transactions.

Now is a good time to set up a couple of pilot users and get experience within your company. Just remember that the meter is running while you're on-line, to the tune of 30 cents to a dollar a minute. Some applications that move a lot of data back and forth are not going to be ideal applications. Lotus Notes, for instance, has a lot more overhead than does Lotus cc:Mail Remote. Over time, as cellular rates go down and as protocols get better, cellular data could be something you want every laptop user to have. Now is a good time to build experience. □



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coveted Editors' Choice Award in the September 26, 1995 issue of *PC Magazine*. And how did Tangent—winner of six previous Editors' Choice awards, with an impressive heritage of superior technology and performance—garner yet two more top awards?

"Top performance, great warranties, and aggressive prices make both Tangents winners."

PC Magazine, September 26, 1995

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PC World Magazine, November 1995

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VIDEOCONFERENCING

The Next Best Thing

Do look now. Desktop videoconferencing, out from the shadow of group videoconferencing, has its own identity.

By Don Labriola

Desktop videoconferencing used to have a bad reputation. It was expensive and hard to install, and it delivered grainy, jerky video that often disappointed first-time users. Worse yet, a lack of comprehensive standards made it difficult or impossible for different brand systems to interoperate without losing functionality.



Illustration by Paul Schulenburg

INSIDE



They're popping up everywhere! Videoconferencing systems are the latest rage, now that pricing, quality, and transport media requirements are settling out. (We don't think of ISDN as the "I" word so much anymore.) Our Network Edition and Connectivity teams meet via video every week.

DON LABRIOLA, A FREQUENT contributor to *PC Magazine* and an authority on videoconferencing, gives us an in-depth look at three leading products this issue. Labriola found the systems much improved since our last big roundup. Video quality is better, interoperability is essentially here, and these systems now deliver lots of teleconferencing features.

IN FIRST LOOKS, WE REVIEW an interesting cousin to those products: C-Phone, from Target Technologies. Reviewer Les Freed says C-Phone uses a unique blend of analog and digital technologies, plus several connection devices, to achieve superior audio/video quality. It's not for the weak spender, though. (Page NE23.)

CONTRIBUTING EDITOR Padraic Boyle reports on another new multi-CPU applications server, the Poseidon MPserver. Although this system won't turn the market upside down, it's a pretty good deal. Boyle says, however, it's missing some management features that comparable servers offer. (Page NE23.)

LES FREED ALSO REPORTS on U.S. Robotics' jump into the ISDN terminal adapter market. Its Courier I-Modem is a combination ISDN TA and V.34 modem. This is a product that makes a lot of sense.

ALSO BE SURE TO CHECK OUT Multiple Access. Steve Buehler, director of PC Labs, West Coast, recommends products that will save you time and trouble but don't require much attention.

—Gail Shaffer

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PC Magazine--January 10, 1995

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GATEWAY	8.6	8.0	7.4	8.2
DELL	8.4	8.0	8.1	7.8
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COVER STORY

Today, most of these problems are no longer showstoppers. Prices are plummeting, ease of use and reliability have improved dramatically, and international standards are emerging at a record pace. But although recent progress has been dramatic, today's breakthroughs are really the culmination of trends that have been under way for years.

Even though it hasn't been long since we last surveyed the field (see "Candid Camera," April 25, 1995), we felt another visit would be worthwhile. We subjected three standards-based systems—the PictureTel Live PCS 50, Intel's ProShare Video System 200, and Vivo's TeleWork-5 (formerly the Vivo320)—to a set of demanding interoperability and usability tests.

Two other contenders weren't available at press time: the latest version of AT&T's Vistium Personal Video 1200, and an as-yet-unnamed Northern Telecom H.320 system that will offer hardware decompression, a software-controlled zooming camera, and auxiliary NTSC (National Television Standards Committee) video input and output jacks.

We found that all three systems had undergone substantial enhancements since the beginning of the year. Tasks that once would have had us crossing our fingers—such as connecting to a group system or scheduling an ad hoc multipoint meeting—are now relatively straightforward. We tested these products over ISDN (Integrated Services Digital Network), which is the best choice for many sites. POTS (the plain old telephone service) cannot provide enough throughput, and higher-

speed links often come at a great price.

We also ran some tests connecting these systems to a group system at Peirce-Phelps, the industry's largest videoconferencing systems integrator, specializing in custom setups (800-862-6800). AT&T WorldWorx Network Services (800-843-3646) allowed us to connect over its links to Peirce-Phelps.

We did run into a few interoperability problems, and the three systems differed significantly in video quality and feature sets. But from the standpoint of reliability and ease of use, it looks as though DVC has finally arrived.

H.320: BEFORE AND AFTER

It has been a long road. For more than a decade, two-way videoconferencing was a niche technology dominated by a handful of small American and British firms. These companies sold proprietary "group" videoconferencing systems that connected groups of people in specially constructed conference centers. Communications were usually limited to long-haul dedicated lines and circuit-switched media such as fractional T-1 and—when it was available—ISDN.

The industry began to break out of its slump in December 1990, when the ITU-T (International Telecommunications Union Telecommunications Standardization Sector) completed its H.320 standard suite. H.320 was a videoconferencing lingua franca that for the first time let different vendors' systems exchange live video and audio and transfer data files.

The standard also guaranteed compatibility with the existing installed base. H.320

helped convince high-rolling multinational companies to enter the market, and within a year, the industry had taken off like a rocket.

The first H.320-compliant desktop systems were introduced in the early 1990s by group-system vendors such as PictureTel and VTEL. Designed for ISDN or Switched-56 communications, they were marketed primarily as add-ons for existing conference sites. These products achieved some success in the group-videoconferencing community, but high hardware prices and tricky digital phone service installation procedures discouraged mass-market interest.

Also, no one could really figure out what to do with the young technology. Group systems, with their large monitors and sophisticated audio systems, provided realistic "you are there" conferencing experiences. But the tiny video windows and limited document-sharing capabilities of the early personal systems made it tough to justify paying top dollar for them.

THE GOLDEN AGE

Today, videoconferencing vendors are working to solve these problems, and things are looking up. Committees have been wrangling over industry standards for years, hoping to arrive at guidelines that will guarantee good performance and interoperability (see the sidebar, "Standards, Standards Everywhere").

And, sensitive to complaints of nightmarish installation experiences, vendors have worked hard to make setup procedures as friendly as possible. Configuring

GLOSSARY

Videoconferencing Jargon

CIF Common intermediate format; a 352-by-288 screen resolution, as defined by the ITU-T H.261 specification. See QCIF.

Coddec Short for coder/decoder; a hardware or software mechanism that translates a video or audio stream between uncompressed analog and compressed digital formats.

Group videoconferencing system A system designed to connect sites where people are meeting around a boardroom conference table. Most group systems sold today are "rollabouts"—bulky, wheeled modules about the size of a large dresser.

G.711 One of the three audio-compression standards incorporated into H.320. G.711 includes the common A-Law and μ -Law protocols.

H.261 The video-compression component of the

H.320 suite.

H.320 A suite of ITU-T standards that describe audio and video compression and transport mechanisms for videoconferencing over dedicated or switched digital lines.

H.323 An impending ITU-T standard that defines videoconferencing over packet-switched local area networks such as Ethernet.

H.324 An impending ITU-T standard that defines videoconferencing over conventional analog (POTS) phone lines.

ISDN Integrated Services Digital Network; the next-generation digital telephone service. ISDN is available in two flavors. 128-Kbps basic-rate interface (BRI) is a common transport medium for H.320-compliant desktop videoconferencing systems. Primary-rate interface (PRI) ISDN

provides 1.54-Mbps throughput for more demanding applications.

MCU Multipoint control unit; a sophisticated multipoint device that assembles three or more point-to-point videoconferencing systems for a multipoint conference.

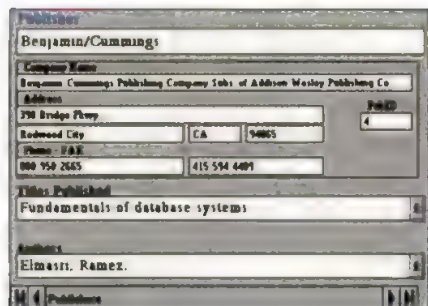
Multipoint teleconference Any teleconference that connects three or more nodes.

Point-to-point teleconference A teleconference that connects two nodes.

QCIF Quarter common intermediate format; a quarter-resolution (176-by-144) version of CIF defined by H.261 for desktop and low-bandwidth videoconferencing.

T.120 An ITU-T standard that defines point-to-point and multipoint document conferencing over a variety of transmission media.

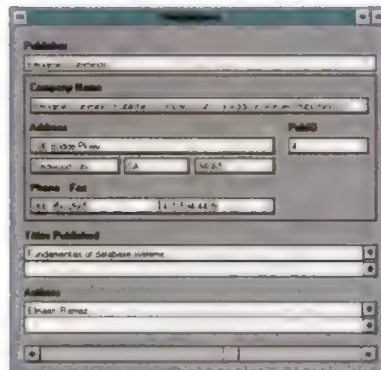
Visual Basic



**28 LINES OF CODE.
AND STILL NO INSERTS.
NO DELETES. NO QUERIES.**

```
Sub PubPubID_Change ()  
Dim SavePlace As Variant  
Dim SQL As String  
If Loading Then Exit Sub  
PubsTitles.Clear  
PubsAuthors.Clear  
SQL = "Select distinct Title from Titles"  
SQL = SQL + " where titles.PubID = " &  
    PubPubID.Text  
DataCtl(PubsList).RecordSource = SQL  
DataCtl(PubsList).Refresh  
Do While Not DataCtl(PubsList).Recordset.EOF  
    PubsTitles.AddItem  
    DataCtl(PubsList).Recordset(0)  
DataCtl(PubsList).Recordset.MoveNext  
Loop  
If PubsTitles.ListCount > 0 Then  
    PubsTitles.ListIndex = 0  
SQL = "Select distinct Author from Titles,  
    Authors"  
SQL = SQL & " where Titles.AU_ID =  
    Authors.AU_ID and "  
SQL = SQL & " titles.PubID = " & PubPubID.Text  
DataCtl(PubsList).RecordSource = SQL  
DataCtl(PubsList).Refresh  
Do While Not DataCtl(PubsList).Recordset.EOF  
    PubsAuthors.AddItem  
    DataCtl(PubsList).Recordset(0)  
DataCtl(PubsList).Recordset.MoveNext  
Loop  
If PubsAuthors.ListCount > 0 Then  
    PubsAuthors.ListIndex = 0  
End Sub
```

Oracle Power Objects



3 DRAG AND DROPS

These two programs do exactly the same thing. But Oracle Power Objects automatically generates the application in less than a minute with three simple drag and drops. Without writing a single line of code.

With Oracle Power Objects you can insert and delete data located on a server database without any modifications whatsoever. To do the same thing, the Visual Basic application would require hundreds of lines of code to be written, tested and debugged.

InfoWorld (8/7/95) confirms: "Unlike Microsoft's Visual Basic (VB), Power Objects is truly object-oriented. And Power Objects boasts cross-platform support that VB can't match." In fact, it lets you run Windows applications unmodified on the Macintosh.

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and debugging an ISDN line—often the trickiest part of an installation—has become much simpler.

Intel, for example, took a step when it introduced its ProShare Personal Conferencing product line. Working with ISDN service providers, the company defined a standard "Intel Blue" offering that made it simple to order ProShare-ready ISDN lines. They cut deals that let VARs sell ProShare for an unheard-of \$999, as long as each system was ordered in conjunction with new ISDN service. Of course, the increasing availability of ISDN expertise at many phone companies has helped ease installation woes.

In addition, long-distance carriers such as AT&T, MCI, and Sprint are offering videoconferencing services. They provide flexible dial-up services such as multipoint conferencing, protocol conversion between incompatible videoconferencing systems, and gateway services that link sites connected to different transport providers. See our sidebar "Multipoint Conferencing Is Real" for an overview and observations on how the tested systems fared.

You may even get a break from high price tags before too long. System costs continue to plummet, thanks in part to the increasing viability of software codecs such as those in Vivo's TeleWork-5 and PictureTel's LiveLAN line.

Prices of nearly all types of peripheral hardware—including cameras, ISDN telephones, and multipoint control units—have dropped significantly. And the next generation of desktop-optimized ITU-T standards—some of which are already being encoded into silicon—may even provide good-looking POTS videoconferencing

PictureTel Live PCS 50

Choosing one system out of these three was not as straightforward as we'd have liked. All three installed easily, featured excellent user interfaces, and provided standards-based interoperability.

We finally awarded our Editors' Choice to the PictureTel Live PCS 50. This is a classy product that produced clearly superior audio and video, and boasted a broad array of videoconferencing and document-conferencing features. Its bundled peripherals were top-notch, and it was the only product we tested to offer hardware-based video decompression. Yes, the price is higher, but in this group, you get what you pay for.

Still, even the PCS 50 isn't perfect. Its application-sharing and remote-control features are abysmally slow, and it works with only a handful of graphics adapters.

Intel's ProShare Personal Conferencing Video System matches much of the PCS 50 feature set, and its applica-

tion-sharing function—although slow—is at least usable. A product in transition, our evaluation unit produced mediocre video quality and suffered from an incomplete H.320 implementation. But if you purchase it with new ISDN service—for \$999—it certainly qualifies as a Best Buy.

Vivo's TeleWork-5 costs more than ProShare, but offers similar video quality and lacks application-sharing capabilities. But it provides better-integrated H.320 support, a terrific interface, and some spiffy videoconferencing features that let you alternate camera output with still graphics, external video sources, and live-video screen capture. It's a competitive, well-designed product.

LiveShare Plus offer advanced functions such as the ability to manipulate a motorized camera plugged into a partner's machine, and password-protected remote-control capabilities that let you operate an unattended off-site computer as though you were sitting in front of it.

Desktop videoconferencing has come a long way. Here's our latest take on some leading products in that market.



tion next year for under \$500.

Last but not least, this past year has seen significant improvements in the applications that give video meetings their substance. Document-conferencing software is coming of age. Robust application-sharing capabilities now let participants jointly operate a third-party program that resides on only one machine.

High-end packages such as PictureTel's

Suitability to Task: Desktop Videoconferencing Systems

Video and sound quality are the most obvious criteria by which desktop videoconferencing systems (DVCs) are judged. But most DVC users quickly find that factors such as document-sharing capabilities and interoperability can be just as important. And desktop videoconferencing systems involve the use of outside telephone company and carrier service connections as well. We gauge how well these systems fared in handling those services.

SUITABILITY TO TASK

Product name

Interoperability/connectivity	Poor
Teleconferencing features	Good
Audio/video quality	Excellent

Interoperability and connectivity describes how reliably a product works with third-party videoconferencing systems, telephone company switches, and carrier services. Support for the H.320 standard's mandatory components is a must. Systems that support the entire H.320 suite—including all three audio-compression algorithms—earn extra points. Compliance with other standards, such as T.120 or PCS, can be a plus.

Teleconferencing features refers to functions that facilitate long-distance meetings. The breadth of a system's application-sharing and whiteboard feature sets are major considerations under this task, as are its degree of integration into the Windows desktop, the presence of still or motion video-capture features,

and automated presentation functions and meeting-administration tools. We also look for features such as OLE support, robust import/export options, background file-transfer capabilities, shared clipboards, and remote-control functions.

Audio/video quality describes how well a system produces understandable speech and how free the video is from defects such as grainy color and low frame rates. Other factors contributing to the rating include maximum video resolution, color accuracy and saturation, video- and audio-tuning capabilities, the effectiveness of echo- and noise-suppression circuitry, and the presence of full-duplex audio operation. The quality of the bundled audio/visual components is another factor. Better cameras and comfortable earpieces improve a system's rating.

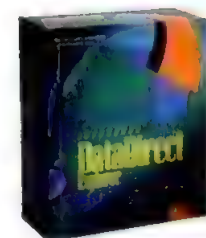
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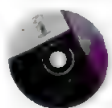


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BENCHMARK TESTS

Videoconferencing



Our evaluation of these desktop videoconferencing systems focused on three areas: connectivity and interoperability, teleconferencing features, and audio/video quality. We also paid close attention to ease of installation, learning, and use.

How We Tested

On our test-beds, we used HP Vectra 590XU 90-MHz Pentium systems configured with 16MB of RAM, Matrox MGA Ultima/Impression graphics adapters, and Hewlett-Packard Ultra VGA 1280 17-inch monitors. We connected each system through a Northern Telecom NT-1 interface to Intel Blue ISDN service ordered from Pacific Bell. Our long-distance carrier was AT&T.

Each of these systems has several components, and anytime users will need to install and learn a new technology that involves both new hardware and new software, there's lots of room for confusion. But since these systems have been around for a few years, we thought they might have become easier to approach than they used to be, and that was the case.

We approached the systems hoping to install each using only its standard documentation package. And, indeed, given this technology's reputation for

difficult installations, setup was surprisingly simple for all three. Installation averaged well under an hour per unit. We did encounter one time-consuming problem, but it was caused primarily (not surprisingly) by a nonfunctioning ISDN line. All three vendors do an admirable job of making setup procedures as painless as possible.

We also investigated how reliably each system's H.320 support allowed it to interoperate with other vendors' equipment. In the course of testing all possible mixed-system combinations, the only problem we found was the PictureTel Live PCS 50's inability to transmit video to the Intel ProShare Video System 200 (a bug that PictureTel was already working to correct as we were testing).

We then connected over the ISDN link to a CLI Rembrandt II/VP group system located in the customer-demo facility of a Philadelphia-based videoconferencing system integrator called Peirce-Phelps. On this test, every connection worked like a charm.

Buoyed by these results, we set up one final interoperability test: a three-node multipoint session that would include one of each vendor's products. Communications were provided by AT&T's WorldWorx dial-up videoconferencing service, which also provided a backbone-attached AT&T Multipoint Control Unit. With one exception—the PCS 50 still couldn't talk to the ProShare system—all systems performed as billed.

ON THEIR OWN

In the second phase of testing, we evaluated each product's feature set and user interface. We looked closely at how well the vendor had integrated its videoconferencing and document-conferencing modules, and paid special attention to advanced features such as application sharing. We also looked for features such as OLE support, shared clipboards, automated presentation features, and video-capture capabilities.

In all three cases, we found outstanding interfaces that were easy to learn and use. Functionality and performance, however, were less consistent. The Vivo Tele-Work-5 lacked key features that were provided by the PictureTel and Intel systems, and only ProShare offered a full-featured application-sharing function that provided acceptable performance on a Pentium/90.

In the area of audio and video quality, we used color and

resolution charts in subjectively evaluating graininess, saturation, color accuracy, and artifacting, and we noted how large motions affected frame rates. We tested cameras under excessively bright, dim, and high-contrast situations, and stressed each product's echo- and noise-suppression systems by using it in a large, noisy room.

Vivo's new ClearView image-sharpening feature provided superior color, while ProShare produced somewhat better frame rates. (Intel plans a low-profile software upgrade before the end of the year that the company claims will significantly improve video quality.)

Where a system supported multiple audio or video codecs, we compared the codec's ability to provide a satisfying conferencing experience. Extra points were given to any system that provided resource-allocation settings that let users juggle the relative priorities of audio, video, and data streams in a multimediateleconferencing.

The PictureTel Live PCS 50 blew away the competition. Its video quality was far superior to that of the Intel and Vivo systems, and its comfortable earpiece and optional speakerphone produced full-duplex audio superior to that of many analog telephones. ProShare, on the other hand, includes an earpiece that many people will find nearly unusable. The Vivo unit suffered from noise-suppression problems.

Intel Corp.

ProShare Personal Conferencing Video System 200

ALL REVIEWS BY DON LABRIOLA

It's remarkable that Intel's ProShare Personal Conferencing Video System has always been pretty easy to use and offered terrific document conferencing—all for a reasonable price. But today it's a product struggling to make the transition from its PCS origins to full H.320 compli-

ance. The units we tested could communicate with other H.320 systems, but provided full functionality only when connected to each other.

Still, ProShare is priced to move. Despite a \$1,999 list price, most units sell for \$999 through a joint-marketing agreement that bundles each system with an order for new ISDN service.

The package includes an Intel Smart Video Recorder motion-video card, microphone/earpiece, ISDN interface, and three software packages. ProShare's full-duplex audio is acceptable, but the hard-plastic

earpiece is nearly impossible to use if you have small ear canals. Frequent users may want to replace it with Coherent Communications System's external Call Port audio module, which Intel resells for \$399.

ProShare's video quality is also in flux. During our lab evaluation, the system's bundled Intel Smart Video Recorder video-capture board produced grainy color and frame rates that rarely exceeded 10 fps. (By the time you read this, Intel plans to have shipped a free upgrade that should improve video quality.)

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COVER STORY



LOTS OF SOFTWARE: Intel includes three different software packages, and its video is improving.

with three software packages. The Intel ProShare Personal Conferencing Video System is the latest version of Intel's original PCS application. It features an easy-to-use videophone-like interface and 352-by-264 video resolution.

Intel's ProShare Video System 200 Room Video Conferencing is a new H.320-compliant version of the PCS package. Its interface is similar, but some functions, including speed-dialing, aren't as easy to use. In addition, picture quality suffers from

number of images.

Giving a presentation is as simple as turning pages. A background file-transfer mechanism automatically transmits graphics before they're displayed. This cleverly averts the delays that plague other packages.

Premier Edition's application-sharing capabilities were the most useful in our survey.

slightly lower frame rates and is limited to QCIF resolution. But the H.320 compliance is good. The only incompatibility we found was an inability to receive video from the PictureTel Live PCS 50—which was due to a bug in PictureTel's software.

Finally, the Intel ProShare Personal Conferencing Premier Edition document-conferencing application offers ease-of-use and performance in a class with any package we've seen. Its tabbed-notebook whiteboard is intuitive and holds an unlimited num-

Although performance slowed somewhat, it was acceptable—unlike PictureTel's extremely slow application-sharing function.

The downside of Premier Edition is that it works only with PCS videoconferences or in data-only sessions over POTS lines. H.320-compliant ProShare videoconferences do not yet have document-conferencing capabilities. Few systems today provide cross-vendor document-conferencing capabilities, but with integrated H.320/T.120 conferencing just around the corner, ProShare may soon find itself at a disadvantage.

Despite its deficiencies, ProShare has a lot going for it—relatively painless installation, superb documentation, a straightforward interface, and superior document-conferencing capabilities. At a street price of \$999, ProShare can be a terrific buy. But

if you're interested only in H.320 teleconferencing, you're better off waiting for the next version. **ProShare Personal Conferencing Video System 200.** List price: \$1,999. Intel Corp., Hillsboro, OR; 800-538-3373, 503-629-7354; fax, 800-525-3019; Web, <http://www.Intel.com/con-net/proshare/index.html>.

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SUITABILITY TO TASK

ProShare Personal Conferencing Video System 200

Interoperability/connectivity	Good
Teleconferencing features	Excellent
Audio/video quality	Fair

PC Mag Does Video Meetings

At PC Magazine we use the tools we write about. We use videoconferencing to link writers, editors, and lab personnel in New York, California, and Florida. Many of us spend a couple of hours a week in videoconferences. Here's how we do video meetings, with a few tips:

❶ Don't use the system's audio. We can't tolerate audio delays during videoconferencing. Any interaction between the participants suffers from processing delays in transmission of both the comments and the reply. As standard practice, we dial up a voice conference on a standard phone line and mute the system's audio. We can tolerate having the lips and sounds out of sync better than we can tolerate delayed sound.

❷ Talking heads do count. Initially, we thought that we'd use these systems to share applications and work on articles. Because we know each other well, we thought that seeing little images of each other, the so-called "talking heads," wouldn't matter. Well, document sharing never materialized. We use Lotus Notes instead. But we find that talking heads are important. We build consensus more easily when we see each other, and we have more confidence in our decisions.

❸ Every team needs an expert. We're a corporation of expert computer users, but this ISDN and video stuff is all different. Each team needs someone who knows what to do

when a video system doesn't work. It's good to appoint someone to get things running before the meeting begins.

❹ Reboot and check the cables. The primary maintenance technique for videoconferencing systems consist of rebooting the PC and checking the cables. The camera and audio system don't use locking connectors. And some applications steal interrupts or memory addresses used by the video and communications subsystems, causing erratic operation. Rebooting, and starting the videoconferencing system before running any other application, often helps.

❺ Slide shows are nice. We use the Vivo's screen sharing to present slide shows using Lotus Freelance or Microsoft Powerpoint. However, it pays to use extra big fonts and to keep the backgrounds simple. Animated slides don't work well.

❻ Look into the camera. In "face-to-face" video discussions with a tight focus on each individual, people should look into the camera instead of looking at the computer's screen or at papers on the desk. If necessary, back off the camera to show the papers and other material.

❼ Side conversations can kill a meeting. If you're in the same room, you can selectively decide which conversation to track. Over a phone link you lose that ability and the side-conversation information as well. — Frank Derfler



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COVER STORY

PictureTel Corp.

PictureTel Live PCS 50



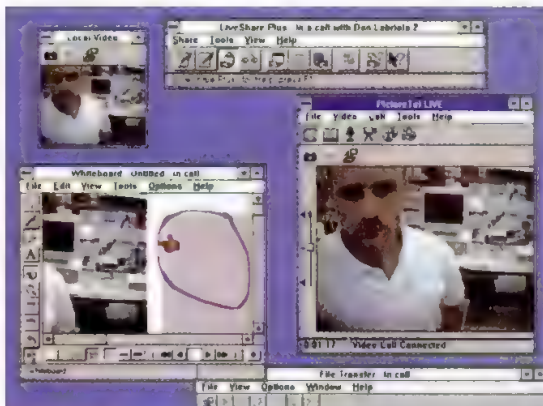
You could say it's the Mercedes-Benz of personal videoconferencing systems. The PictureTel Live PCS 50 offers outstanding audio and video quality, robust H.320 support for superior interoperability, and a broad selection of document-conferencing features. And as with the Mercedes, the price is higher, but there's no question that you're getting a higher-caliber product.

Just to get started, you'll need to cover the \$2,495 base price, and you'll have to replace your graphics accelerator with one that includes a VESA Advanced Feature Connector (VAFC) and packed-pixel mode-frame buffer. Our test units included PictureTel's own \$300 1MB ISA card, as well as an optional \$500 ISDN speakerphone, which brought the

total price to \$3,295.

Still, the PCS 50 easily produced the best video and sound of the products we surveyed. Also, installing the PCS 50's auto-configuring jumperless codec board was a breeze. The VAFC graphics adapter required minor tweaking, but the procedures were well documented. In addition to the excellent documentation, all connectors are color-coded or marked with icons. It took only about 90 minutes to set up both systems.

The PCS 50 easily produced some of the top video and sound of the products we surveyed, and this was the only unit capable of both transmitting and sending at CIF resolution. The color was relatively free from grainy mottling, and its frame transmit rates often approached 15 frames per



IT'S A WRAP: The PCS 50 transmits relatively grain-free color as well as a credible illusion of motion.

second (fps), providing a credible illusion of motion.

The PictureTel Live PCS 50 is also the only system in its price range to avoid cost-saving compromises such as software-based video decompression. Its superior Sharp YH7B50 camera boasts a

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Standards, Standards Everywhere

The Telecommunications Standardization Sector of the International Telecommunications Union—known as the ITU-T—is the primary standards-making body for the videoconferencing industry. Headquartered in Geneva, Switzerland, the ITU is a

United Nations-sponsored standards body with membership representing more than 170 governments. The ITU-T's 1990 approval of the H.320 standard revolutionized teleconferencing by enabling different manufacturers' videoconferencing systems to interoperate for the first time. Since then, work has continued on a variety of H.320 follow-ups, many of which are finally reaching completion.

Standards development for personal applications hasn't kept up with the explosive growth of desktop-conferencing technology. Intel and the Personal Conferencing Work Group announced their intention to develop PCS standards last year. But now that ITU-T's leadership is no longer in question, progress is occurring at an unheard-of pace. Working with bodies like the ATM Forum and the Multimedia Communications Forum, the ITU-T has made significant progress in areas such as multiple document conferencing and POTS video conferencing over Ethernet.

Here's a quick rundown of the ITU-T's most important teleconferencing standards.

H.320 is a suite of specifications that define how videoconferencing systems communicate over circuit-switched media such as ISDN, fractional T-1, or Switched-56 lines. A key component of H.320 is the H.261 video-compression algorithm, which defines two video resolutions: 352-by-288 CIF (Common Intermediate Format) and 176-by-144 QCIF (Quarter Common Intermediate Format). H.320 also includes three audio codecs designed to handle a broad range of applications: G.711, which uses 64 Kbps of bandwidth to provide 3-KHz telephone-quality audio; G.722, a higher-quality algorithm that produces 7.5-KHz audio but consumes up to 64 Kbps of bandwidth; and G.728, which, despite providing near-telephone audio, requires only 16 Kbps.

H.310 and H.321 adapt H.320 to next-generation topologies such as ATM and broadband ISDN. H.321 provides maximum backward compatibility by retaining H.320's overall structure and some of its components, including H.261. H.310 adds the ISO's MPEG-2 video-compression algorithm, which will provide HDTV-class video quality. As we go to press, H.310 is scheduled to be Determined and H.321 to be Decided at the next ITU-T meeting in November 1995.

H.322 is an enhanced version of H.320 optimized for networks that guarantee Quality of Service (QoS) for isochronous traffic such as real-time video. It is expected to be first used with IEEE 802.9a isoEthernet LANs. H.322 should be Decided in November.

H.323 extends H.320 to Ethernet, Token-Ring, and other packet-switched networks that don't guarantee QoS. It will support both point-to-point and multipoint

operations. In addition to H.320's H.261 video codec and G.711 audio codec, H.323 implementations can also include H.320 and H.324 components such as H.263, G.722, G.723, and G.728. QoS issues will be addressed by a centralized gatekeeper component that lets LAN administrators manage video traffic on the backbone. Another integral part of the spec defines a LAN/H.320 gateway that will allow any H.323 node to interoperate with H.320 products. H.323 is scheduled for Determination in November.

H.324 brings H.320-like videoconferencing to analog POTS phone lines. It can incorporate H.261 video encoding, but most implementations will probably use H.263, a scalable version of H.261 that adds a 128-by-96 Sub-QCIF (SQCIF) format. Because of H.263's efficient design, it may produce frame rates much like those of today's ISDN H.320 systems through inexpensive hardware-assisted modems. The ITU-T expects to Decide H.324 in November.

T.120 is a document-conferencing specification that lets users share documents during any H.32x videoconference. Data-only T.120 sessions can be held when no video communications are required, and the standard also allows multipoint meetings that include participants using different transmission media. The mandatory components of T.120 have been finalized, including recommendations for multipoint file transfer and shared-whiteboard implementation. Still under way are efforts to standardize reservation-system protocols—needed to organize large multipoint meetings—remote camera and mic control and real-time QoS management. Technical challenges have so far prevented the inclusion of a robust application-sharing specification, although T.120's T.126 component does define rudimentary app-sharing functionality. At the moment, only Databeam's FarSite 2.0C incorporates the completed portions of T.120, but most vendors plan to release compliant products in 1996.

THE STANDARDS PROCESS IN A NUTSHELL

The ITU-T's standards-approval process requires recommendations to complete three milestones.

Determination: When an ITU-T study group agrees that the intent of a recommendation's technical content is complete, the group's chairman declares it to be Determined. A Decision to Put to Ballot is then scheduled for the next ITU-T meeting. During the intervening six to nine months, precise wording and technical details are finalized.

Decision to Put to Ballot: The final version of the recommendation's text is presented to the attending ITU-T membership. If no Member country objects, the document is scheduled for a formal vote and the recommendation is considered Decided. At this point, the recommendation is virtually guaranteed approval, and manufacturers can safely develop compliant products.

Ballot: Ballots are sent to the ITU-T's general membership. If 70 percent of the respondents approve the recommendation over the next 90 days, it's officially published.

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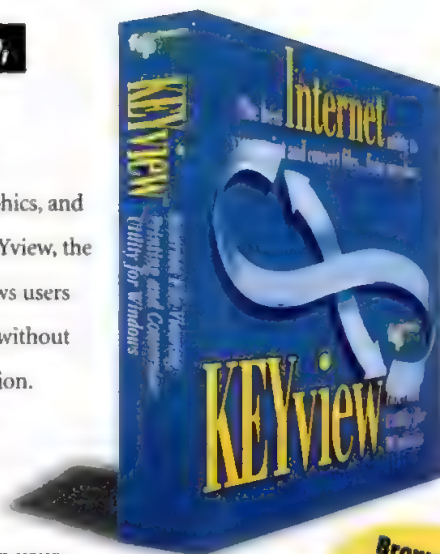
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SUMMARY OF FEATURES

Videoconferencing Systems



■ YES ■ NO	Intel ProShare Personal Conferencing Video System 200	PictureTel LIVE PCS 50	Vivo TeleWork-5
Products listed in alphabetical order			
List price of tested configuration (per seat)	\$1,999	\$3,295	\$1,495
Hardware			
CPU required	486 or better	386SX or better	Pentium/60 or better
RAM required	8MB	8MB	8MB
Hard disk space required	14MB	20MB	5MB
Bundled components (tested configuration)	Camera, earpiece, ISDN S/T interface, microphone, video-capture card	Camera, earpiece, ISDN S/T interface, microphone, video-capture card	Camera, headset, ISDN S/T interface, microphone, speakers, video-capture card
Options	Coherent Call Port Full-Duplex Desktop Audio System (\$399)	1MB VAFC ISA graphics adapter (\$300), ISDN speakerphone (\$500), 2MB VAFC PCI graphics adapter (\$500)	None
Number of slots required	Two ISA-16	One ISA-16*	Two ISA-16
Videoconferencing Features			
Videoconferencing software	Intel ProShare Personal Conferencing Video System 200 1.8, Intel ProShare Video System 200 Room Video Conferencing 1.8	PictureTel LIVE 1.5.01	Vivo320 1.5
Full-duplex audio	■	■	■ (with headset)
Hardware compression/decompression	■ ■	■ ■	■ ■
Video window resolution (maximum)	176 x 132 (H.320 mode), 352 x 264 (PCS mode)	352 x 288 (H.320)	352 x 288 (H.320)
Video window resolution (recommended)	176 x 132 (H.320 mode), 352 x 264 (PCS mode)	352 x 288 (H.320)	176 x 144 (H.320)
Graphics-adapter video connector	None	VESA Advanced Feature Connector (VAFC)	None
Communications mechanisms supported	BRI ISDN, LAN	BRI ISDN	BRI ISDN
Still/motion video capture	■ ■	■ ■	■ ■
Remote camera control	■	■ (when used with a controllable PTZ camera)	■
Video codecs supported	H.320, Indeo	H.320	H.320
Audio codecs supported	G.711, GSM	G.711, G.722, G.728, PT724	G.711, G.722
Document Conferencing			
Document-conferencing software	Intel ProShare Personal Conferencing Premier Edition 1.8	PictureTel LiveShare Plus 2.0.0	DataBeam FarSite 1.10
T.120 support	■	■ (first quarter 1995)	■ (requires upgrade to FarSite 2.0C)
Application sharing	■	■	■
Shared whiteboard	■	■	■
Private whiteboard area	■	■	■
Users must work on same page	■	■	■
Shared clipboard	■ (during application sharing)	■	■
Chat mode	■	■	■
Remote control	■	■	■
OLE support	■ (1.0 client only)	■	■
Presentation features	Multipage whiteboard, view-only application-sharing mode	Prints presentation to whiteboard, sorts slides	FarSite ScreenShow, ScreenView (proprietary)
Technical Support			
Toll-free technical support	800-538-3373	800-874-2835	800-848-6411
On-line support	CompuServe, Web, BBS	BBS	CompuServe, Internet, Web

* The PictureTel LIVE PCS 50's graphics adapter requires an additional ISA or PCI bus.

dynamic range broad enough to produce good contrast under lighting too dim for reading.

The earpiece/microphone that came standard with the system was the only one we found comfortable, and the optional speakerphone provides full-duplex audio that was cleaner than that of most analog phones. Its audio circuitry includes sophisticated features such as echo and noise suppression, as well as automatic gain control.

The bundled PictureTel Live videoconferencing software has an intuitive interface that makes it easy to auto-dial and receive calls. It displays both local and remote video in floating windows that you can arbitrarily resize by simply dragging with the mouse. There's a good selection of options and preference settings, as well as advanced features such as the ability to control the motorized camera on a remote PictureTel rollabout system.

The PictureTel LiveShare Plus document-conferencing software is even more impressive. The software boasts password-protected remote control, multiple applications sharing, and a shared clipboard that allows one user paste whatever the other has copied.

Our only disappointment was the system's performance during application-sharing and remote-control operations. Applications run normally on their host system, but remote participants must endure tortuously slow screen redraws.

Interoperability was excellent. The PCS 50 was the only system here that supported all three H.320 audio-compression standards, as well as a high-performance proprietary algorithm. The only problem we encountered was an inability to transmit video to ProShare systems. PictureTel plans to address this problem in its next software revision (due around the end of 1995).

The PCS 50 is high-priced, but it provides a desktop videoconferencing experience that's as good as it gets.

PictureTel Live PCS 50. List price: Basic system, \$2,495; 1MB VAFC ISA graphics adapter, \$300; ISDN speakerphone, \$500. PictureTel Corp., Danvers, MA; 800-716-6000, 508-762-5000; fax, 508-762-5243; Web, <http://www.PictureTel.com>.

Circle 952 on reader service card

SUITABILITY TO TASK

PictureTEL Live PCS 50

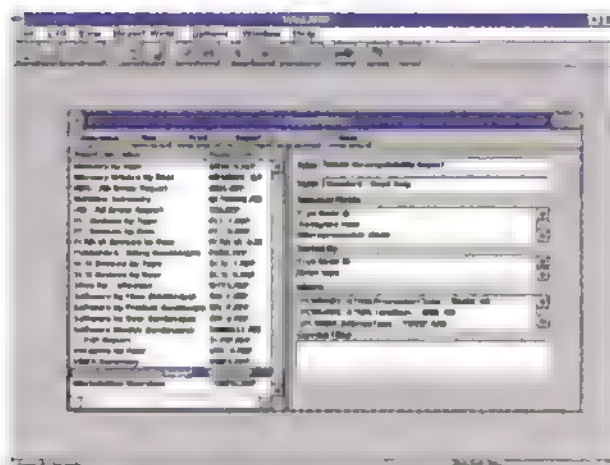
Interoperability/connectivity	Excellent
Teleconferencing features	Excellent
Audio/video quality	Good

How do you find out if your users' hardware configuration is Win '95 compatible?



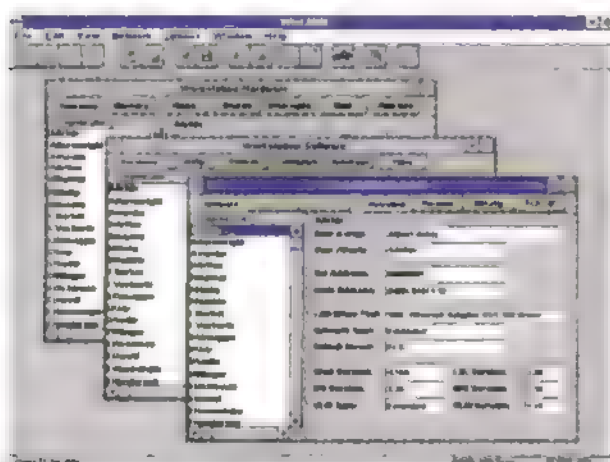
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Incompatibility Report from the list of standard reports. In addition, the report writer is completely customizable and allows you the flexibility to choose general fields to search from and then to sort based on criteria within those fields. The combinations are unlimited.



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WinLAND easily and quickly inventories hundreds of hardware and software items on your networked PCs, saving you hours of work. The software master with thousands of titles lets you automatically identify software on each PC worksta-

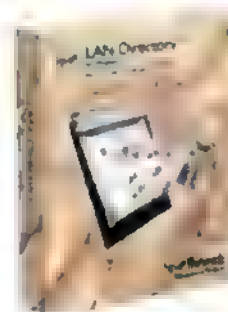
tion. Collect key files including: AUTOEXEC.BAT, CONFIG.SYS, SHELL.CFG, NET.CFG, LANMAN.INI, DOSLAN.INI, PROTOCOL.INI, WIN.INI and SYSTEM.INI. Inputting administrative information such as asset tags and serial numbers gives you a complete database of information.

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Multipoint Conferencing Is Real

Point-to-point teleconferencing may be on the verge of becoming routine, but designing and implementing a multipoint solution is another story. Regardless of the transmission medium, coordinating three or more real-time audio/video/data streams almost always requires a backbone-attached switching device and advance planning.

Moreover, when you're working with packet-switched networks such as Ethernet, the problem is compounded by a lack of multipoint videoconferencing standards. A few proprietary LAN solutions—such as Corel Corp.'s CorelVideo and Datapoint's MINX line—try to bypass the problem by routing uncompressed video through a parallel network managed by a proprietary hub. They deliver outstanding video quality without disturbing regular LAN traffic, but they aren't cost-effective for hooking up small numbers of users. Upcoming ITU-T standards (see "Standards, Standards Everywhere") will make it easier for next-generation products to provide nonproprietary videoconferencing over Ethernet, Token-Ring, or Iso-Ethernet LANs.

It's a lot simpler to hold multipoint meetings over wide area digital media such as ISDN or Switched-56. All you need is access to a device called a Multipoint Control Unit (MCU), which can automatically assemble three or more video streams into a single multipoint meeting. Advanced models (which can cost upwards of \$80,000) organize dozens of users into multiple simultaneous conferences. Long-distance carriers such as AT&T, MCI, and Sprint all provide transparent dial-up access to H.320-compliant MCUs.

MCUs also perform bridging services—such as reconciling systems running at different transmission speeds—and provide functions such as voice-activated switching, which ensures that participants always see the person who's speaking. In addition, newer MCUs let users with T.120-compliant software share documents during a multipoint session.

High-volume users may find it cost-effective to integrate a lower-priced MCU, such as Teleos's \$19,995 four-port VideoRouter Express, into their in-house telecommunications environment. Another alternative is Target Technologies' \$3,995 C-Phone Multipoint Controller; when combined with the company's LAN-based C-Phone video PBX and multipoint H.320 codecs, it can produce mixed LAN/ISDN multipoint sessions in which four users are visible on the screen at the same time. (Be sure to see our first look at C-Phone on page NE23. It's a more complex hardware setup

than the products reviewed in our main roundup here. But it uses a blend of analog and digital technologies to produce video that is of extremely good quality.)

MULTIPOINTING WITH THE REVIEWED SYSTEMS

All this may sound complicated, but setting up a no-frills ISDN multipoint connection is actually rather simple. When we tried connecting our Intel, PictureTel, and Vivo evaluation units in a three-way meeting, our biggest problem was deciding on a service provider. We finally settled on AT&T's WorldWorx Network Service, which offers a variety of point-to-point and multipoint audioconferencing, videoconferencing, and data-conferencing services.

The first step was to register each system with AT&T. We completed a short Room Profile form and participated in a preservice test to verify that our systems and communications lines were configured properly. In our case, they weren't, but AT&T specialists quickly figured out the problem and devised a solution. The whole process took about 15 minutes.

Once we were registered, multipoint conferences with as many as 23 participants could be scheduled with less than a day's notice. Although pricing can vary, average costs run about \$1 per minute per participant.

Our first multipoint conference went surprisingly smoothly. Each unit came on-line a few seconds after we dialed in and worked like a charm for the duration. To make the test a little tougher, we ran the PictureTel at CIF resolution, ran the Intel at QCIF, and let the Vivo send QCIF and receive both CIF and QCIF. The AT&T MCU automatically reconciled the formats with aplomb.

We noticed minor video degradation, but audio was sharp and always in sync. The voice-activated switching, however, took a few minutes to get used to. In order to minimize false triggers caused by background noise, switching doesn't occur until a person has been talking for a few seconds. So long as only one person speaks at a time, the system works fine. If participants interrupt one another or try to talk at the same time, a meeting can quickly degenerate into chaos.

We were unable to share documents during our multipoint conferences, because none of our evaluation units provide cross-vendor document-conferencing capabilities. But even if they did, WorldWorx currently offers integrated video- and data-conferencing only for AT&T Vistium systems. In most other ways, however, H.320 multipoint conferencing over ISDN can be considered a reality.—DL

Vivo Software Inc.

TeleWork-5

Even in this small roundup, we certainly saw a range of products. Vivo's \$1,495 (list) TeleWork-5 is the first H.320 system to incorporate an all-software codec. (Software video codecs generally rely on your computer's host processor to compress and decompress video.) Its picture quality isn't up to par

with that of the hardware-based systems, but the Telework-5 is better than you'd expect. Its H.320 compliance made for excellent interoperability.

This system transmits video at QCIF resolution and can receive either QCIF or CIF. Our evaluation unit delivered 10-fps video on talking-head shots, but even small motions by conferees cut frame rates in half—and transferring a file or graphic image stopped the picture dead in its tracks. Still,

picture quality was generally satisfying, thanks to its new ClearView image-sharpening feature, which reduced color mottling.

Vivo produces its own H.320 video software, then bundles with it an IBM WaveRunner Digital Modem ISDN interface, Logitech's MovieMan video-capture board and VideoMan digital camera, and the FarSite collaboration software. It also includes an inexpensive multimedia-style speaker and headset.

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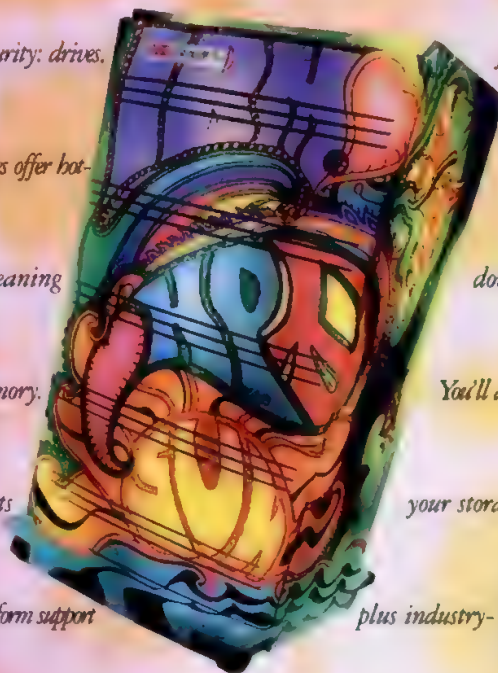
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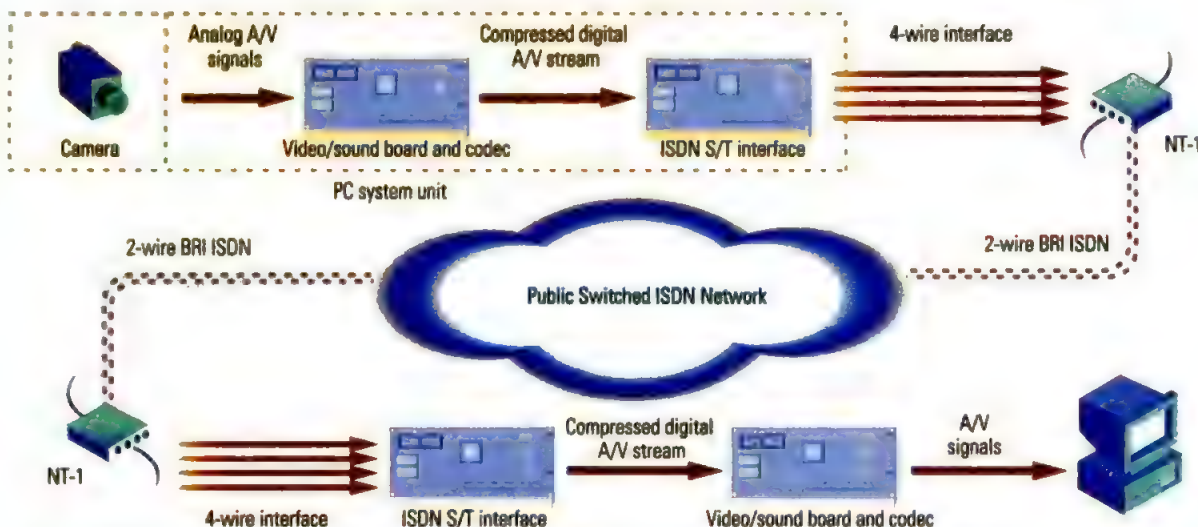
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CIRCLE 931 ON READER SERVICE CARD

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Point-to-Point Videoconferencing over ISDN

In addition to the desktop videoconferencing products, you'll need to secure ISDN service (plus any additional hardware needed), and you'll need to give up two slots in your PC.



The TeleWork-5 supports H.320's G.711 and G.722 audio codecs and provides full-screen video on systems equipped with DCI-compliant graphics adapters. Virtual serial-port drivers let the bundled WaveRunner ISDN interface work with communications packages that normally require modems and analog phone lines.

Installing our two evaluation units took only 70 minutes, thanks to an impressive automated setup program. The TeleWork-5's sound system, however, left something to be desired. The speaker and microphone were feedback-sensitive, and their half-duplex audio stream was repeatedly interrupted by background noise in our busy lab environment (consider where you'll situate it). Its headset provided full-duplex audio, but while not as bad as ProShare's earpiece, was not very comfortable.

Although it ships with an old version of Databeam Corp.'s FarSite, the TeleWork-5 will work with a variety of document-conferencing packages. FarSite offers a good selection of presentation features and, on our P90 test system, took only about 5 seconds to scroll a slide onto the screen. Unfortunately, the bundled version lacks some functions you might be looking for, such as application sharing, remote control, OLE support, a chat mode, and a shared clipboard.

The newer Vivo320 1.5 videoconferencing software (included) fills in some of the gaps with an innovative Screen View function that transmits an arbitrary region of

SUITABILITY TO TASK

TeleWork-5

Interoperability/connectivity	Excellent
Teleconferencing features	Good
Audio/video quality	Fair

your screen as live video. During our evaluation, we found this feature useful for rudimentary one-way application-sharing or for transmitting a presentation-graphics screenshow. A single click on the toolbar lets you switch your video source among the primary camera, an auxiliary camera or VCR, a ScreenView region, or a graphic such as a business card or captured still image. Other recent enhancements include support for H.320's G.722 audio-compression algorithm and new resource-management options that let you set maximum and minimum frame rates and prioritize video and data bandwidth consumption.

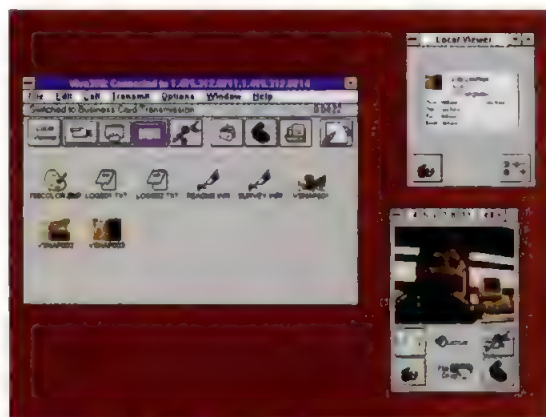
Vivo's H.320 compatibility was flawless. The TeleWork-5 worked transparently with the Intel and PictureTel products, and the CLI rollabout systems. During our multipoint sessions, the system switched effortlessly between ProShare's QCIF and the PCS

50's CIF output video streams.

The TeleWork-5 is decidedly easy to install, is simple to use, offers well-integrated H.320 compatibility, and includes a number of unique features. It suffers, however, from limited document-sharing capabilities and unexceptional video and audio. If you're looking for high quality in those areas—and you're willing to spend the money to get it—you're probably looking for PictureTel right now.

Telework-5. List price: \$1,495. Vivo Software Inc., Waltham, MA; 800-848-6411, 617-899-8900; fax, 617-899-1400; Web, <http://www.vivo.com>; e-mail, info@vivo.com.

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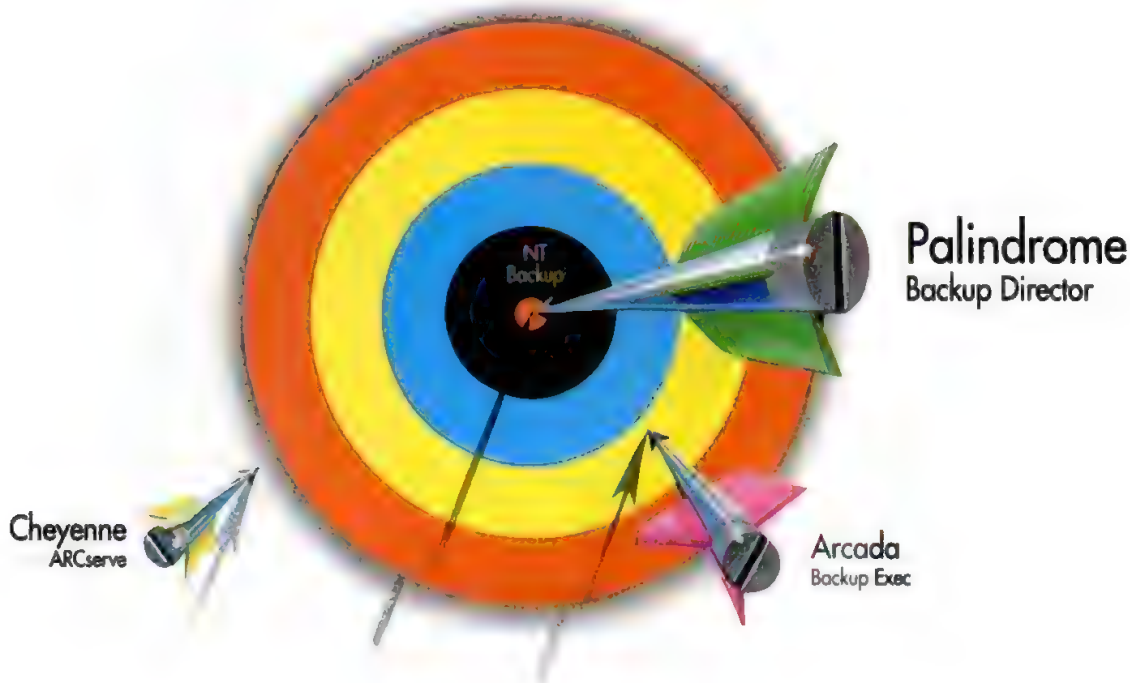
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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

APPLICATION SERVERS

Poseidon's Average Adventure

By Padraic Boyle

Compared with the other multiprocessing servers in its class, the new MPserver from Poseidon Technologies is in many ways a good deal. The MPserver, which provides symmetrical multiprocessing (SMP) with up to four Pentium processors, offers solid performance, flexibility, and expandability at a price (\$32,000) well below that of its recently covered competition ("Souped-Up Servers," November 21, 1995). The product does have some shortcomings, however, particularly in the management area, which may sway you toward one of the higher-priced servers.

One of only four vendors shipping a four-processor system, Poseidon distributes the MPserver through a host of VARs as well as direct channels for large corporate accounts. The MPserver is scaleable enough for most applications,

including file and print servers, yet is really more suitable as a video or SQL database server.

In addition to the 3.5-inch floppy disk drive, the MPserver's tower chassis can accommodate six half-height hard disks and four 5.25-inch drive bays for storage. The hard disk subsystem uses a Mylex 960P PCI SCSI-II adapter that connects the four Fast-Wide 2.2GB hard disks to the server.

Unfortunately, the MPserver's drives aren't hot-swappable, which means you must shut down the server if a drive failure occurs. (The HP Net-Server 5/100 LS4, which was Editors' Choice in our recent roundup, provides hot-swappable drive subsystems.) For an additional \$500, a dual power supply can be installed for redundancy.

The MPserver can support up to four 90-MHz, 100-MHz, or 120-MHz Pentium proces-

sors. Four PCI and four EISA slots and one shared ISA/PCI slot make up the rest of the system board. The unit we tested has four Pentium 90-MHz chips, a Cogent Quartet Ethernet adapter, and an SVGA video adapter.

The system board doesn't have integrated devices, so you have to use slots for video and the floppy disk-I/O adapters. By contrast, Compaq's ProLiant 4500 integrates the video, SCSI, and floppy disk controller onto the system board to conserve slots.

The MPserver's memory banks are easily accessible and can hold a maximum of 256MB of ECC (error correction code) RAM on the system board. If needed, an additional 512MB of RAM can be installed using an optional memory board. But this is where the MPserver has

problems. The optional memory board shares a slot with the fourth processor board, which forces you to sacrifice memory for an additional processor or vice versa. According to Poseidon, this will be addressed in the next-generation MPserver, which will support seven PCI and four EISA slots and will accommodate four processors and up to 896MB of RAM when fully configured.

Unlike Compaq's SmartStart package, the MPserver does not come with any utilities to ease the installation process. Depending on your level of expertise, this may or may not be a drawback. Moreover, there are no management tools for troubleshooting the server. Poseidon says that by mid-1996 a Windows management package will be available that will

Continues on page NE28

VIDEOCONFERENCING

The C-Phone Gets an A-Plus

By Les Freed

Articles about LAN-based videoconferencing systems are typically sprinkled with terms like "bandwidth bottleneck," "grainy," "jerky motion," and other less-than-favorable expressions. But this isn't one of those articles. Target Technologies' C-Phone Video Conferencing System wouldn't allow it. The C-Phone (\$1,995 per client) is a clever blend of analog and digital technologies that provides first-rate videoconferencing without the usual bandwidth demands and picture quality problems.

To put the C-Phone's operating method in perspective, it helps to consider a little video history. The National Televi-

sion Standards Committee (NTSC) standard, which is used for full-motion color video—the kind you see on broadcast TV—was created in the late 1940s. Because the standard was designed for over-the-air broadcast television, signal bandwidth wasn't an issue. (Television channels are spaced 6 MHz apart. So even with a 1-MHz guard band between channels, there was still room for a 3-MHz-wide video signal.) And because it was developed in the 1940s, NTSC is entirely analog.

The NTSC picture consists of 525 lines scanned at a rate of 30 frames per second. Converting that analog signal to digital form is possible, but the resulting data stream is huge—about

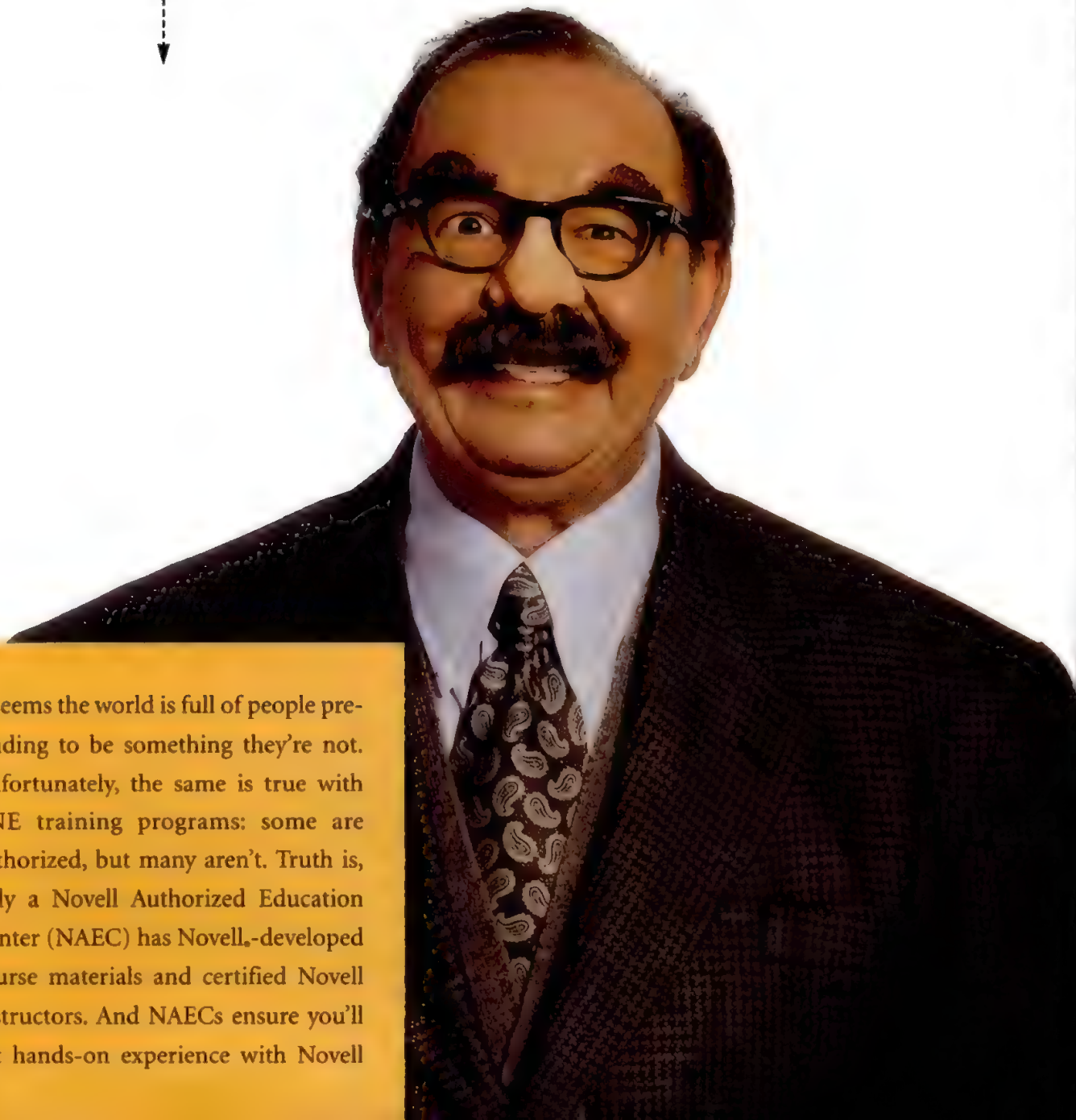


THE MPserver from Poseidon Technologies has a tower chassis that can accommodate six half-height hard disks and four 5.25-inch drive bays for storage. Priced well below its recently reviewed competition, the MPserver is a solid performer, though it lacks somewhat in the management area.

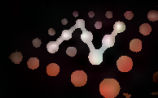
The first thing you need to know about wolves in sheep's clothing is that they're not necessarily wearing sheep's clothing.



It seems the world is full of people pretending to be something they're not. Unfortunately, the same is true with CNE training programs: some are authorized, but many aren't. Truth is, only a Novell Authorized Education Center (NAEC) has Novell,-developed course materials and certified Novell instructors. And NAECs ensure you'll get hands-on experience with Novell



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NETWORK EDITION

First Looks

72 megabits per second for a 640-by-480 256-color image. Though the data can be compressed to a more reasonable size by using MPEG or other data compression schemes, the resulting picture is often grainy or jerky.

of the C-Phone Video Conferencing System that operates over 10Base2 Ethernet cable. In addition, the C-Phone system places virtually no computing load on the workstation PC, nor does it add any LAN traffic to the 10Base-T network.



I "C" YOU: The CCD camera supplied with the C-Phone Video Conferencing System produces a respectable picture.

The C-Phone Video Conferencing System capitalizes on the NTSC system, however; it transmits a real NTSC video signal in analog form when connecting over the LAN. The C-Phone VIM (Vendor Independent Messaging) unit overlays the NTSC video over your VGA board's output. There is no analog-to-digital-and-back-again conversion, so the resulting picture is remarkably sharp and clear.

The C-Phone Video Conferencing System is also quite progressive in its use of the LAN's resources. Most corporate LANs run over 10Base-T unshielded twisted-pair (UTP) cabling. While 10Base-T networks don't have enough bandwidth for full-motion video, the twisted-pair cable used in those networks does. Although the 10Base-T specification calls for four-pair cabling, only two pairs are actually used for the LAN. The other two are not connected to anything at all.

The folks at Target Technologies saw these unused pairs and decided they'd make a great video distribution system. Target offers another version

The C-Phone system consists of a monitor-mounted camera/speaker/microphone unit (CSM), a video interface module (VIM), an ISA interface card, and a telephone handset. The system requires a Windows PC with at least 4MB of RAM, a Network Interface card, and a video card with a VESA feature connector.

To connect the C-Phones, you need a special C-Phone 10Base-T hub. Target's 8-port hub is an additional \$699, and multiple hubs may be stacked to add additional users.

Installing the C-Phone system is complicated, but only because there are so many connections to make. The board uses one or two IRQ lines, a DMA channel, and an I/O address. The second IRQ line is necessary only if you plan to record video from the conferencing system onto your hard disk.

The C-Phone Video Conferencing System is a hardware-based system, so there's very little software to install. The entire C-Phone package fits on three 3.5-inch disks, and the installation process takes only a few minutes.

Once installed, the C-Phone is extremely simple to operate. Target calls the C-Phone a "Video PBX," and the telephone switchboard analogy is appropriate. The C-Phone software provides telephone-like features, including station-to-station calling, call transfer, and voice mail. And the system uses a visual dialing directory; each directory entry can hold a thumbnail image of the person being called. An optional Multipoint Control Unit (\$3,995) provides four-way conference calling.

The supplied fixed-focus CCD camera produces a decent picture, but you can also plug a VCR, camcorder, TV tuner, or laserdisk player into the C-Phone system. We connected a Sony Handycam camcorder to the C-Phone and were impressed with the clarity of the picture and sound.

An optional WAN interface provides shared access to the outside world via an ISDN, T-1, or T-3 line. The \$2,495 C-Phone WAN Server is a dedi-

cated, rack-mountable PC with an H.320 codec board and BRI ISDN interface, providing compatibility with most ISDN videoconferencing systems. One WAN server can host several codecs and ISDN interfaces.

This arrangement allows you to share expensive codecs and ISDN lines among several users. We placed several H.320 calls; all recipients reported that the C-Phone's H.320 mode was as good as any they've seen.

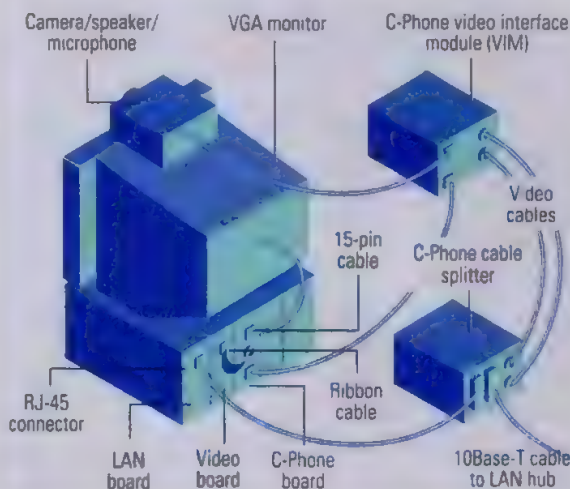
The C-Phone package also includes DataBeam's FarSite document-sharing software. FarSite complies with the T.120 document-sharing standard and operates on the LAN as well as over H.320 connections.

C-Phone Video Conferencing System. List price: \$1,995 per workstation. Target Technologies Inc., Wilmington, NC 28405; 910-395-6100; fax, 910-395-6108; e-mail, 75457.3165@compuserve.com.

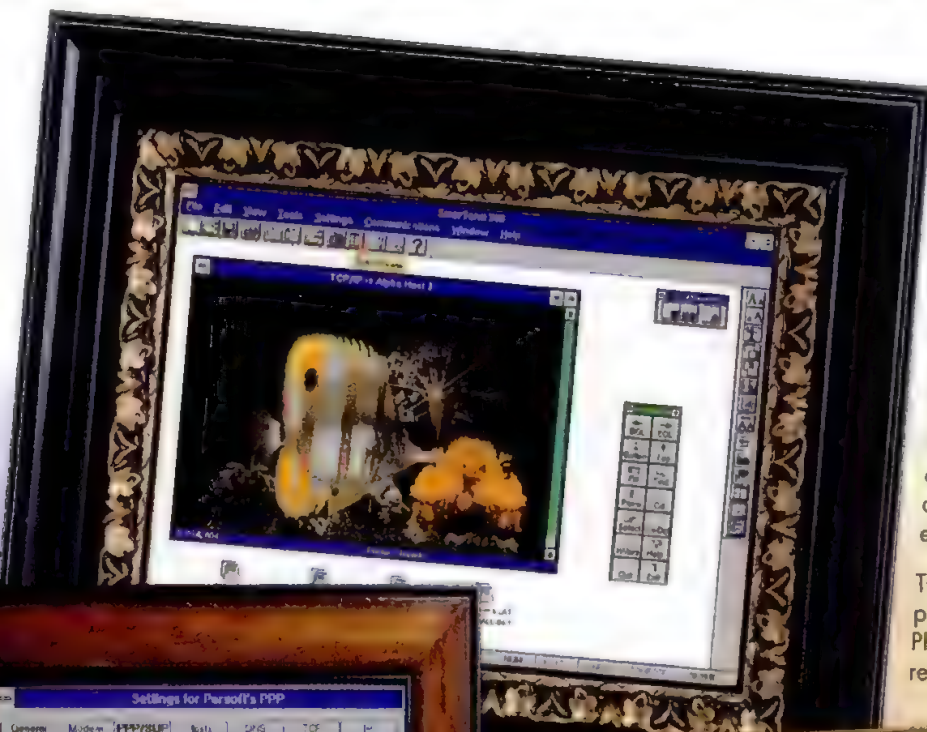
Circle 968 on reader service card

Setting Up the C-Phone

You install the C-Phone board next to your video board and run a ribbon cable to your video board's VESA feature connector. Move your monitor cable from the video board to the C-Phone board. A short jumper plugs into the monitor socket on your video board and connects to the C-Phone board. A 15-pin cable connects the C-Phone board to the VIM, and another connects the VIM to the camera. Two cables connect the VIM to a cable splitter box, from which the 10Base-T cable runs to the LAN.



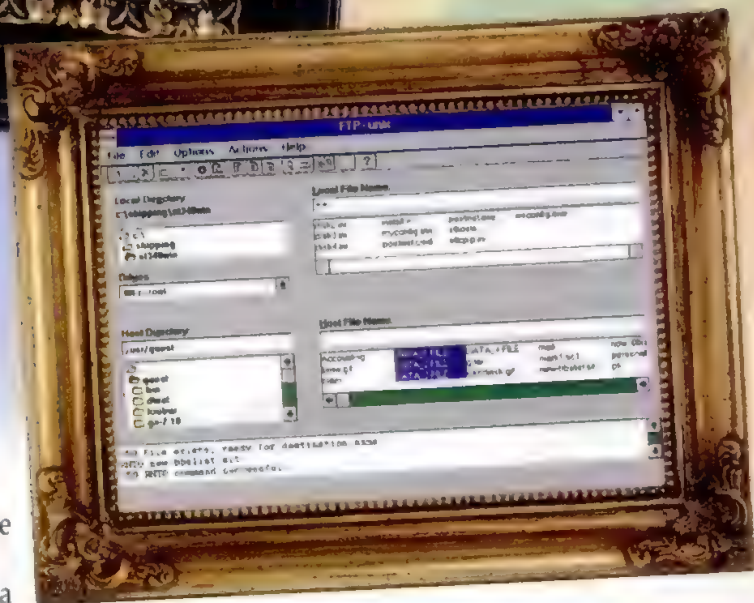
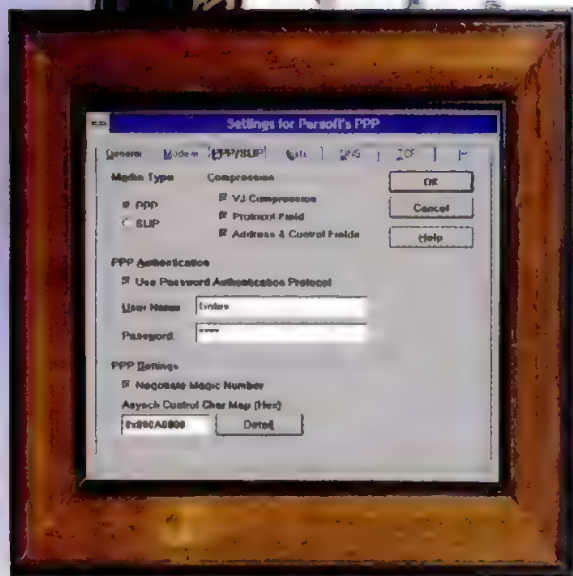
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First Looks

HIGH-SPEED MODEMS

Making the Combined Connections

By Les Freed

Something fast and something "slow"—at least in terms of data transmission—is what you get with U.S. Robotics' Courier I-Modem, the first combination ISDN TA and V.34 modem on a single ISA card that we've seen. U.S. Robotics has made a significant jump into the ISDN terminal adapter market with this product, and by the time you read this, an external version should be available.

The Internal I-Modem is available in three models. We tested the \$795 Model 1, which includes an integrated NT-1 interface and an analog telephone jack to connect external

modems, fax machines, or a telephone. The \$745 Model 2 is the same as the Model 1, minus the analog port. The \$595 Model 3 deletes the analog port and the integrated NT-1.

At first glance, the I-Modem's ISDN TA and full-featured 28.8-Kbps V.34 combination may not seem to make sense. After all, isn't ISDN supposed to make modems obsolete? In theory, yes—but in reality, we still have to deal with analog modems, fax machines, and POTS telephones. The I-Modem provides access to the digital world of ISDN yet maintains a firm grasp on the existing analog world.

Now, before we go any further, here's a little-known

ISDN fact: You can call an ISDN line from any POTS phone and vice versa. Most ISDN TAs can route incoming calls according to the caller type. So, for example, if you call an ISDN phone number with another ISDN TA, the I-Modem will recognize the incoming call as digital and will answer it as a digital data call. But if you call the same number with a POTS telephone, the I-Modem will route the call to the external telephone plugged into the I-Modem. In some areas you can ask the phone company to give you separate phone numbers for analog and digital calls.

The I-Modem can also adapt itself to outgoing calls. For example, if you call one of CompuServe's local dial-up numbers, the I-Modem knows there's a modem at the other

end and sets itself up for a V.34 call. But if you call directly to CompuServe's ISDN number in Atlanta, the I-Modem sets itself up for a 64-Kbps ISDN call.

The essential point is that you can use the I-Modem and a single ISDN line to replace two POTS lines. As a bonus, you'll get completely error-free ISDN connections, crystal-clear voice calls, and more reliable V.34 and fax calls. In most places, you'll get all this for less money than two POTS lines will cost you. Local phone tariffs vary widely, so check with your local phone company before disconnecting those POTS lines.

PLUGGED IN AND READY

From the PC's point of view, the I-Modem looks like a stan-

Continues on page NE30

Poseidon

Continued from page NE23 provide statistics on ECC memory, CPU statistics, RAID monitoring status, and a thermal detector.

The MPserver did well on our benchmark tests. Using software RAID 5, the TPS (transactions per second) steadily decreased from a peak

of 110 with 12 clients to 73 with 60 clients, nearly the same as with three processors. This performance degradation is a characteristic of other multiprocessor systems as well and directly correlates to the disk drive subsystems. Poseidon claims, as do other vendors, that the memory cache can be tweaked for specific applications.

Poseidon's MPserver was

generally an average server adventure. Although the MPserver is missing a few crucial features, its price is relatively low, and its performance is good and solid. If you can live without hot-swappable drives, a management package, and an installation assistant, and if the MPserver meets your applications and budget needs, you can't go wrong by choos-

ing this server. But if you want more management options and hot-swappable drives, researching your other server options is probably a wise idea.

MPserver. List price: \$32,000. Poseidon Technology Inc., Sunnyvale, CA; 408-733-3378; fax, 408-733-1934; e-mail, poseidon@netcom.com.

Circle 967 on reader service card

BENCHMARK TESTS

MPServer



We set up Poseidon's MPserver on a 60-node Ethernet network. Each of the four segments on our network included ten 486DX/33 PCs and five 386DX/33 PCs from various manufacturers. For all our tests, the client systems were evenly distributed across the four Ethernet segments.

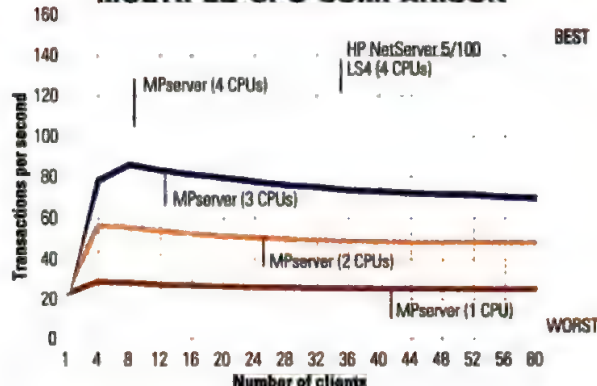
We tested the server by running ServerBench 2.0 over Microsoft Windows NT Server 3.51 with TCP/IP as the transport protocol. ServerBench

simulates a client/server database application and measures the rate at which the server processes client requests.

We submitted workloads starting with 1 client, then 4 clients. We then raised the load in 4-client increments until we reached 60. The results show the number of transactions per second processed for each number of clients.

For our **Multiple CPU Comparison** tests, we test each server with one to four 100-MHz Pentium processors, 256MB of RAM, and data striped across four 2GB hard disk spindles. Complete results are shown for each machine

MULTIPLE-CPU COMPARISON



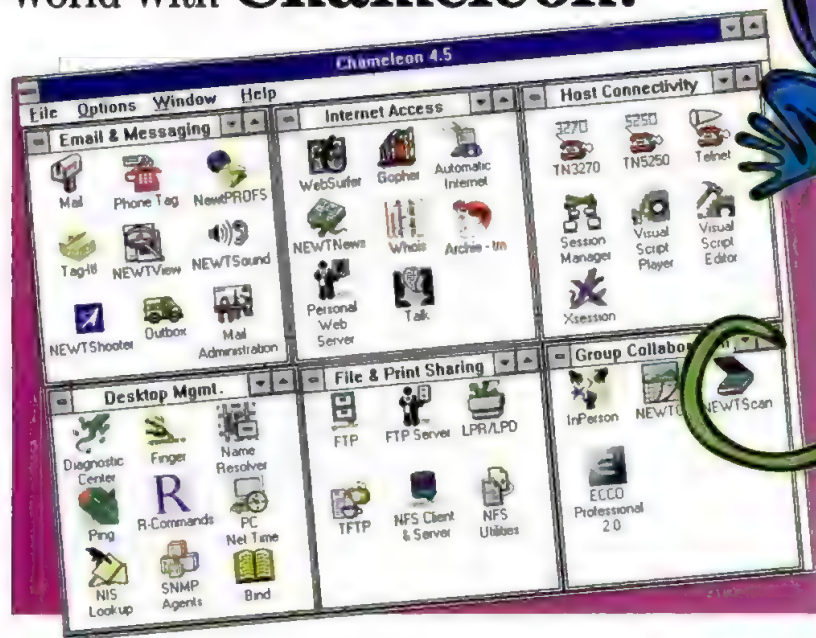
configured with software RAID. For comparison, we show the results for the HP Net-

Server 5/100 LS4, the Editors' Choice in our recent roundup of multi-CPU servers.

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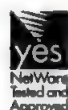
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File & Printer Sharing
NFS Client & Server*
FTP Client & Server
LPR/LPD
Electronic Mail & Messaging
SMTP Mail with MIME
IBM PROFS
Phone Tag, Tag It
Calendar/Scheduler
Internet Access
WWW Client & Server
Gopher
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Archie
Whols
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First Looks

NETWORK BACKUP

Enjoy the VISTA

By Steve Rigney

Managing a network backup system is usually based more heavily on faith than science. If you want to know whether the backup worked, you typically must go to the file server running the backup software and generate a report or perform a scan of the backup medium. If you have only one or two file servers, this procedure isn't so burdensome, but if you manage backup systems for dozens of file servers stretched across a WAN, it simply isn't feasible.

Fortunately, Palindrome Corp. has arrived at a solution—Visual Storage Administrator (VISTA), Version 1.0, which allows you to monitor Palindrome Storage Manager and Backup Director installations from a central location. With VISTA, you can monitor your backup, archive, and HSM tasks in real time, and if a problem arises after you leave the office, VISTA will notify you via e-mail, SNMP alerts, a pager, or a network broadcast.

For \$1,995, you get VISTA's management console with five agents (VISTA runs on any Microsoft Windows-based network client). VISTA can monitor the Palindrome network backup systems running on both NetWare 3.x and 4.x file servers, but you must have Version 4.0 of Backup Director and Storage Manager.

If you're running an older version of a Palindrome product, it will be necessary to upgrade before you can use VISTA. Symantec has a similar product, called Norton Enterprise Backup, but unlike VISTA, it can control and monitor only network backup, not HSM or archiving.

VISTA uses a series of NLMs to communicate between the backup installations and the management PC. We installed the agent NLMs on a NetWare 3.12 and a NetWare 4.1 file server. The hub NLM requires about 1MB of memory, and the agent NLMs need only 500K of RAM.

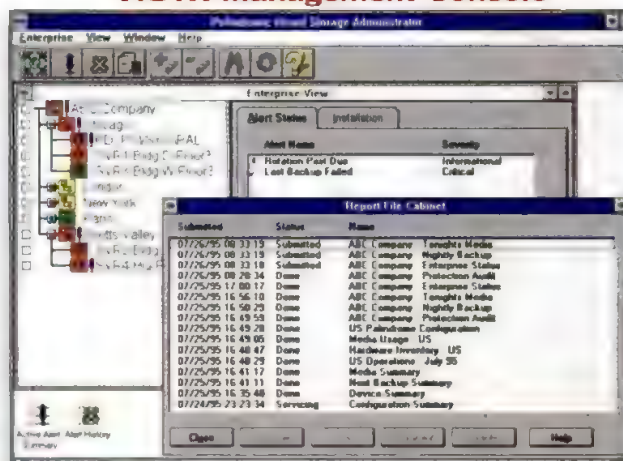
After we installed the NLMs and the management software, we were able to

monitor and control the Storage Manager software running on the two file servers. We could determine what tape was currently loaded in the 4-mm DAT drive and what tape

version of VISTA doesn't allow you to export reports to other file formats, such as comma-delimited ASCII or dBASE.

One of our favorite features

VISTA Management Console



MANAGE IT: You can monitor dozens of different servers and backup installations, as well as the status of each resource.

should be inserted for our nightly backup. And when we installed the wrong tape in the drive, we automatically received an error on the VISTA management console.

In addition to monitoring this information in real time, you're able to use VISTA to generate detailed reports that can be printed or saved as ASCII files. Unfortunately, this

in VISTA is its smooth integration with NetWare 4.1's NDS (NetWare Directory Services). Because of the integration, you can monitor your NetWare 4.1 servers, users, and backup devices from a single graphical tree. You can also monitor a file server down the hall and a file server 2,000 miles away, from the same menu. Our only complaint is

U.S. Robotics

Continued from page NE28

dard data/fax modem. It uses only one COM port address and one IRQ line—a blessing for today's resource-crowded PCs. Hardware installation is typical: Select a COM port address and an IRQ line and plug in the board.

The I-Modem also supports Plug and Play if you have a PnP-compatible machine. An included configuration program walks you through setting up your ISDN-line parameters and also provides a quick operational test of the I-Modem. If you're running Windows 95, U.S. Robotics provides an .INF file that tells Win 95 all about

the I-Modem.

Because the I-Modem looks like a standard modem, it worked well with every software package we tried, including Attachmate's Crosstalk for Windows, CompuServe's WINCIM, Microsoft Exchange, and Spy's Internet in a Box.

In addition, the Courier I-Modem supports several ISDN standards for true interoperability. It supports both the V.120- and V.110-rate adaption standards (these are North American and European standards, respectively). The I-Modem also supports OPI and NDIS drivers, which allow it to appear as an Ethernet network interface card.

Many in the industry believe that Internet access—and the World-Wide Web in particular—will be the “killer app” that draws users to ISDN. The I-Modem supports Internet connections via PPP (at 64 Kbps) and Multipoint PPP (at 128 Kbps). We tested the I-Modem with PSI's Interramp ISDN service, and it worked flawlessly. FTP file transfer speeds (as clocked by Netscape) averaged around 11 KBps—just about as fast as a 115.2-Kbps serial port can go.

Our only quibble with the I-Modem was its lack of a standard ring signal to the POTS jack. When the I-Modem senses an incoming analog call, it

activates a ringer mounted on the I-Modem board. Therefore, an answering machine or fax connected to the POTS jack won't auto-answer. External TAs like Motorola's BitSURFR and 3Com's Impact provide a real 90-volt ring signal to attached devices, and USR claims that the external I-Modem will, too. But aside from that, we were impressed with how smoothly the I-Modem's dual nature was implemented.

Courier I-Modem. List price: \$595 to \$795. U.S. Robotics, Skokie, IL; 800-342-5877; fax, 708-676-7320; Web, <http://www.usr.com>; e-mail, usr@support.com.

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1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.

Continued from page NE30
that some of VISTA's menus, although accessed from an attractive user interface, aren't particularly intuitive, and unless you're familiar with Backup Director or Storage Manager, you'll need a few days to learn how to get to the information you want.

In addition to working with NetWare's IPX/SPX protocol, VISTA runs over the TCP/IP network protocol. This is handy, especially if you're running TCP/IP on your corporate backbone. VISTA also works with dial-up connections, including ISDN and frame-relay.

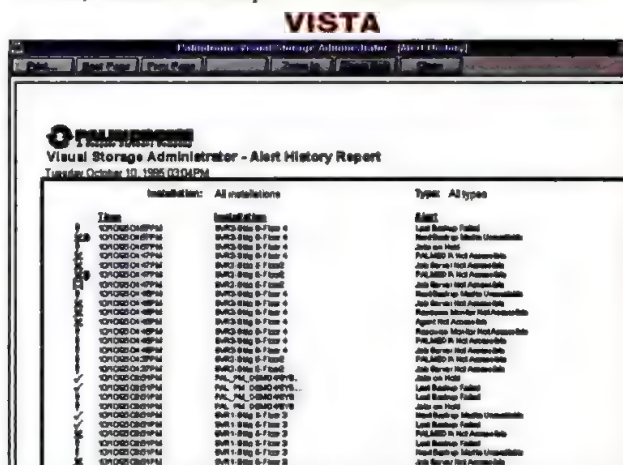
As for security, VISTA lets you set up passwords to keep intruders out of your backup information. You can set up different levels of access, based on

In addition, VISTA has dozens of different alerts, including ones for tape drive problems, incomplete backup, HSM information, and rotation errors. Each alert is given an "informational" or "critical" level, and you can change the alert level for any errors. You can also disable alerts you don't need or want. Once received, alerts can also be saved for future reference.

If you are using Palindrome's Storage Manager or Backup Director and have approximately five servers in different locations, VISTA will definitely streamline network maintenance costs. Monitoring multiple servers simultaneously is much more efficient than hiring a network manager for each location or traveling back and forth between

VISTA, Version 1.0. *List price:*

Circle 966 on reader service card



RED ALERT: Monitor your backup servers in real time or use customized reports to monitor backup alerts.

Generation Jumping

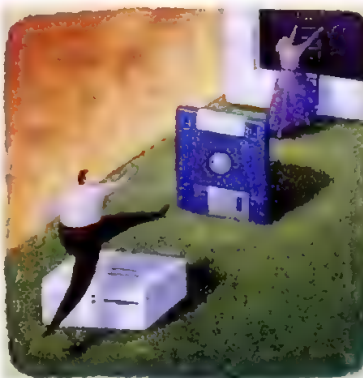


I recently read a news tidbit about IBM's Micro Channel customers wanting PCI machines from IBM in the future. It reminded me of Micro Channel's early days. IBM's enormous publicity campaign promised this technology would not only run the next-generation operating system of choice (OS/2) but, because of its

architecture, would support future computing needs we didn't even know we had.

Well, as it turned out, those first Micro Channel machines couldn't run that next-generation OS, and it appears PCI is now the technology of choice for both Micro Channel and EISA users. I'll bet the people who stuck with ISA and are just now switching to PCI machines may be feeling pretty smug.

This generation jumping certainly isn't a new phenomenon. (Do you know anybody who regrets skipping DOS 4.0?) I can think of several personal experiences where jumping a generation was at best a good idea and at worst no real loss. There was that network manager in my company, for example, who started buying 386 machines when the rest of us were just starting to buy 286s. We criticized his profligacy. Our machines, after all, cost only about a third what his did. But his first-generation 386s proved to be useful a lot longer than our later-generation 286s.



Then there was the business that cabled a new building with IBM Type 1 cable because that's what IBM's new network protocol, Token-Ring, required. At the time, of course, the business didn't have any networks, but it was planning for the future. Of course, by the time it started deploying networks, Type 3 cable was the standard for both Ethernet and Token-Ring.

I once had to make a similar cabling decision. Some months prior to the date the 10Base-T standard was supposed to be finalized, I had to select a contractor and provide a detailed cabling diagram for a major move scheduled to take place a few months after that date. I chose to hold back, to cable every cubicle with coax and use multipoint repeaters (no more than six stations per segment). It worked great.

Cable failures were nonexistent. But afterward I wondered if my conservatism hurt the division in the long run. When Cat 5 cable became the recommended standard, I felt better. Since this company moved departments or divisions around every couple of years, from floor to floor or building to building, skipping Cat 3 probably didn't hurt a bit.

Sometimes it makes sense to buy ahead of the curve. Sometimes it make sense to hold back. It's not till after we've passed beyond a technology that we can tell for sure if it was worth the hassle, and our value assessment is bound to be situation-

dependent. So be kind to those who take a different path. It may be *your* crystal ball that's wrong.

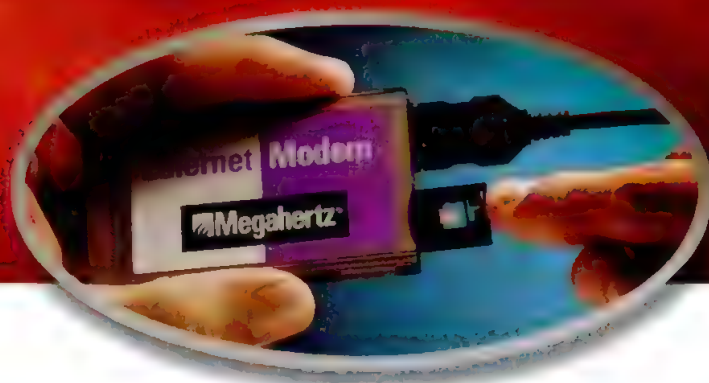
Diane Danielle, an independent networking consultant, can be reached on CompuServe at 72241,2566 or MCI Mail at 383-1159.

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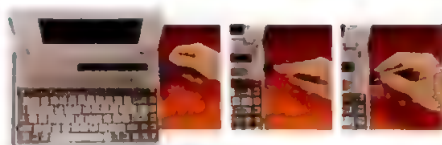
The Professor & Mary Ann

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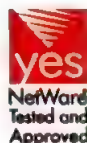
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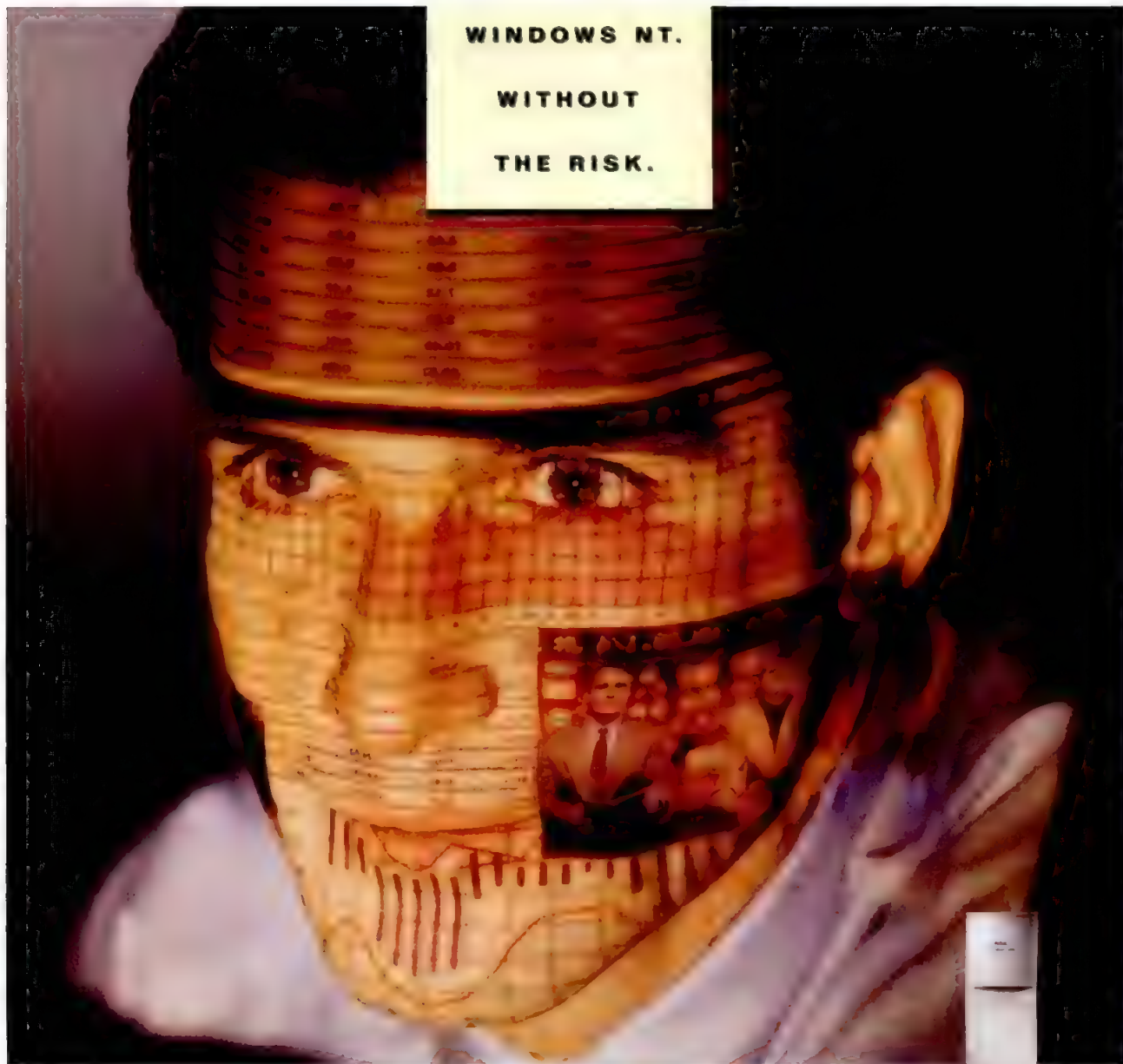


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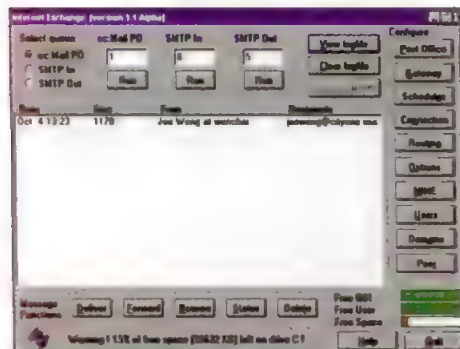
New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Eryn Brown

Central House Updates Its cc:Mail Gateway

One of the most popular cc:Mail Internet gateways is now available in a new version. **Central House Technologies** has announced Internet Exchange for cc:Mail 1.1. The SMTP/MIME gateway features new file attachment capabilities for cross-platform Mac and PC exchange. It also offers rules-based address translation and destination-based attachment handling.



INTERNET EXCHANGE'S CONFIGURE SCREEN lets you manage cross-platform file exchange.

Internet Exchange for cc:Mail, Version 1.1. List price: \$3,395; upgrade, free. **Central House Technologies**, Plymouth CA; 209-245-5900; fax, 209-245-5919; e-mail, jrohde@ima.com.

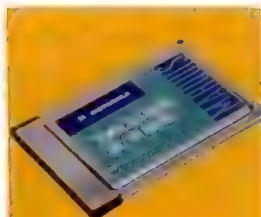
Circle 954 on reader service card

Cisco Ships Router for ISDN Remote Access

The first product to emerge out of **Cisco Systems'** September purchase of Combinet is the **CiscoPro CPA753**, an ISDN remote-access router. It handles voice, data, and fax communications, routes IP and IPX, and works with the Multilink PPP protocol. It has an analog interface to connect directly to phones and fax machines, as well as an Ethernet port, an internal NT-1, and an S/T port. The router is available in models supporting four or unlimited users.

CiscoPro CPA753. List price: \$1,200 and up. **Cisco Systems Inc.**, San Jose, CA; 800-462-4726; Web, <http://www.cisco.com>.

Circle 955 on reader service card



HOT PROSPECT

LAN, Data, Fax, and More—All on a PC Card

Sound like a gadget you'd like to play with? **Motorola's PCMCIA Products Division** has released two new PC Cards, the Marquis and the Mariner, that pack in a lot of punch. The Marquis provides 28.8-bps data and fax communications and also functions as a 10-Mbps Ethernet adapter. It comes with cables for the LAN and modem, easy-to-use installation software, and QuickLink Mobile software, which provides advanced scheduling and dialing functions.

The Mariner takes all the features of the Marquis and adds in cellular and paging capabilities. It can connect to cellular phones and one-way alphanumeric pagers, as well as Motorola's two-way Tango pagers. The Mariner incorporates Message Partner, a Motorola software package that provides a number of services, including the ability to print, save, and delete downloaded pager messages on a computer. It also comes with SystemSoft's CardWizard Pro, which assures compatibility with all leading portable computers.

Marquis. List price: \$599.

Mariner. List price: \$599.

Motorola PCMCIA Products Division, Schaumburg, IL; 800-427-2624; fax, 708-538-4495; Web, <http://www.mot.com>.

Circle 964 on reader service card

A Wyse Use of Windows For Display Terminals

Not everyone has access to a PC—especially in training- or transaction-oriented environments. Enter the Winterm terminals. Part of **Wyse Technology's** Terminal 2000 line, Winterm will communicate with Windows NT application servers (including a customized version of Citrix's WinFrame), delivering Windows functionality at a fraction of the cost of a PC. The units are designed



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to be rugged and should integrate easily into existing mainframe or PC environments.

Winterm terminals. List price: \$500 and up. **Wyse Technology**, San Jose, CA; 408-473-1200; fax, 408-473-2080; Web, <http://www.wyse.com>.

Circle 956 on reader service card

Purveyor WebServer Available for NetWare

Already available for Windows NT, Windows 95, and OpenVMS, **Process Software's** Purveyor WebServer will also be available in a NetWare version by the end of 1995. The package will run on 3.x and 4.x installations. It will incorporate new features, including proxy servers for HTML, Gopher, and FTP requests. It will also now work with the SPX network protocol.

Purveyor WebServer for NetWare. List price: Not available. **Process Software Corp.**, Framingham, MA; 800-722-7770. Web, <http://www.process.com>; e-mail, info@process.com.

Circle 963 on reader service card

Unix Management from Syntax and Fujitsu

Here's a Unix-based network management tool that promises to deliver considerable power. **Syntax** is now shipping the TotalNet Administration and Management Server, which combines the company's TotalNet Administration Services with **Fujitsu's** NetWalker network management technology. The product will provide a single point of administration control, and will monitor configuration and status over heterogeneous installations. NetWalker provides a graphical interface, complete with visual network schematics.

TotalNet Administration and Management Server. List price: \$995 per server, \$30 per client; Syntax Inc., Federal Way, WA; 206-838-2626; fax, 206-838-9836; Web, <http://www.syntax.com>; e-mail, marketing@syntax.com.

Circle 962 on reader service card

BRIEFS

HARDWARE

Cray Communications is shipping the new MatchBox ASIC-based Ethernet switches, in 24- and 36-port configurations (\$240 and \$197 per port, respectively). The switches support virtual LANs and can be configured on a port-by-port basis. 301-317-7336.

SOFTWARE

Landmark Systems has introduced PerformanceWorks (\$7,500 and up), an applications performance management package for large client/server installations. It includes SmartAgents for a variety of operating systems, SQL and ODBC interfaces, and an SNMP interface. 800-488-1111.

Business Takes Place on The Internet—Really

You've seen the headlines and watched the Sunday morning talk shows. So where are those business opportunities on the Internet? **Connect's** OneServer Digital Product Distribution System (DPDS) may provide one: electronic software distribution. The system works over the Internet or through private networks; it comes with client software and tracks software sales, licensing, and distribution. It also features browsing capabilities that let you build a kind of electronic storefront—especially useful for the sale of multimedia elements.

OneServer Digital Product Distribution System. List price: \$80,000 and up. Connect Inc., Mountain View, CA; 800-262-2638; 415-254-4000; fax, 415-254-4800; Web, <http://www.connectinc.com>; e-mail, info@connectinc.com.

Circle 957 on reader service card

MULTIPLE ACCESS By Steve Buehler

Set and Forget



Plug and Play is a great idea for users, but what most network administrators want is Set and Forget. Like everyone else, network administrators are squeezed for time and resources. Any tools that save time and money and require little attention while they help managers

cope with the daily demands of their jobs are worth investigating. If, on top of that, they also improve service or reduce costs, everyone wins.

You see this approach in many high-end network management products. Now, though, it's rolling out to products aimed at the smaller-LAN markets. Two such Set-and-Forget products that recently crossed my desk address specific situations I've had to cope with in my career. Each is the kind of product a network administrator can use to reduce costs while improving the service users want.

First, one for backup. Nobody likes hearing about system backup. You spend some person's time (maybe your own) to swap and label tapes and send them off-site, and you pray you can get your data back when you need it. Of course, getting that data usually involves considerable time finding the tape, restoring, and checking whether you got the right file.

Now suppose you could install a backup program that ran

when you wanted, scanned your backup data for viruses, compressed it, and sent it off-site over ISDN to a remote site. Further, suppose you could get your data back any time you wanted through a simple Windows interface. Once you're set up, you need do nothing to make this system secure: Off-site backups just happen. That's the thinking behind XactData 2.0, from XactData Services (Seattle, WA; 800-585-5300). Now that XactData is working with several telcos to provide the complete solution, this is a product that can save you time and money with better service for your users. At around \$1,500 to set up and \$400 to \$600 a month for a 5GB backup, it's pretty reasonable.



Another product I found interesting is ModemCheck, from Baranoff Software (Watertown, MA; 800-462-4565). With all the time I spend on the road, I find it frustrating to be unable to dial in for my remote access when a modem's down or hung. Since most of the time I'm calling in from another time zone or outside of normal business hours, it's really tough to get my IS department to be responsive about fixing the hung modem.

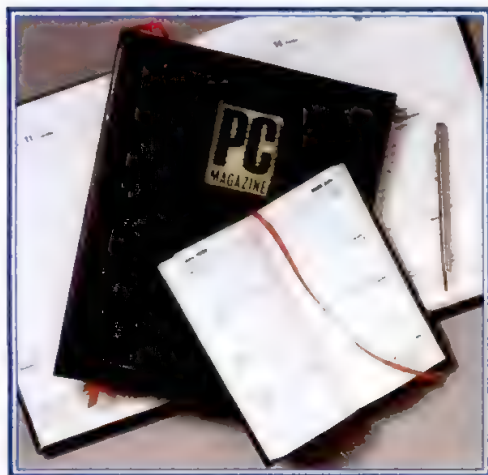
ModemCheck is a rather simple program that calls your inbound modems on a regular basis, making sure that modems on those numbers (and rollovers, too) are accessible for your remote warriors' use anytime. It allows you to specify modem numbers to call, time periods to call, and alert

procedures to follow. As long as you've got a Windows-capable computer and a spare modem, this is a great investment at \$295.

With more tasks to do in less and less time, you need more products like these to help you keep your users happy. I'll tell you about more such tools in upcoming columns.

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If you're reading this before November 13, 1995, you can join the awards ceremony live on that date at 8 pm Pacific Standard Time (the ceremony is held at Comdex in Las Vegas, NV). After this date, you can visit the award site until September 1, 1996.

In order to visit the Technical Excellence awards, you'll need Internet access. You'll also need to download the client software, follow the connection instructions, and familiarize yourself with any applicable Worlds Inc. charges. You can do so from the following services:

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PC Magazine CD Winter 1995 (Vol. 3, Disc 4)

A Pentium for Every Desktop!

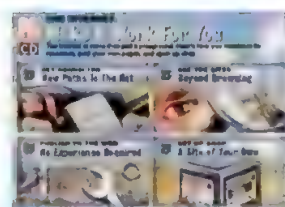
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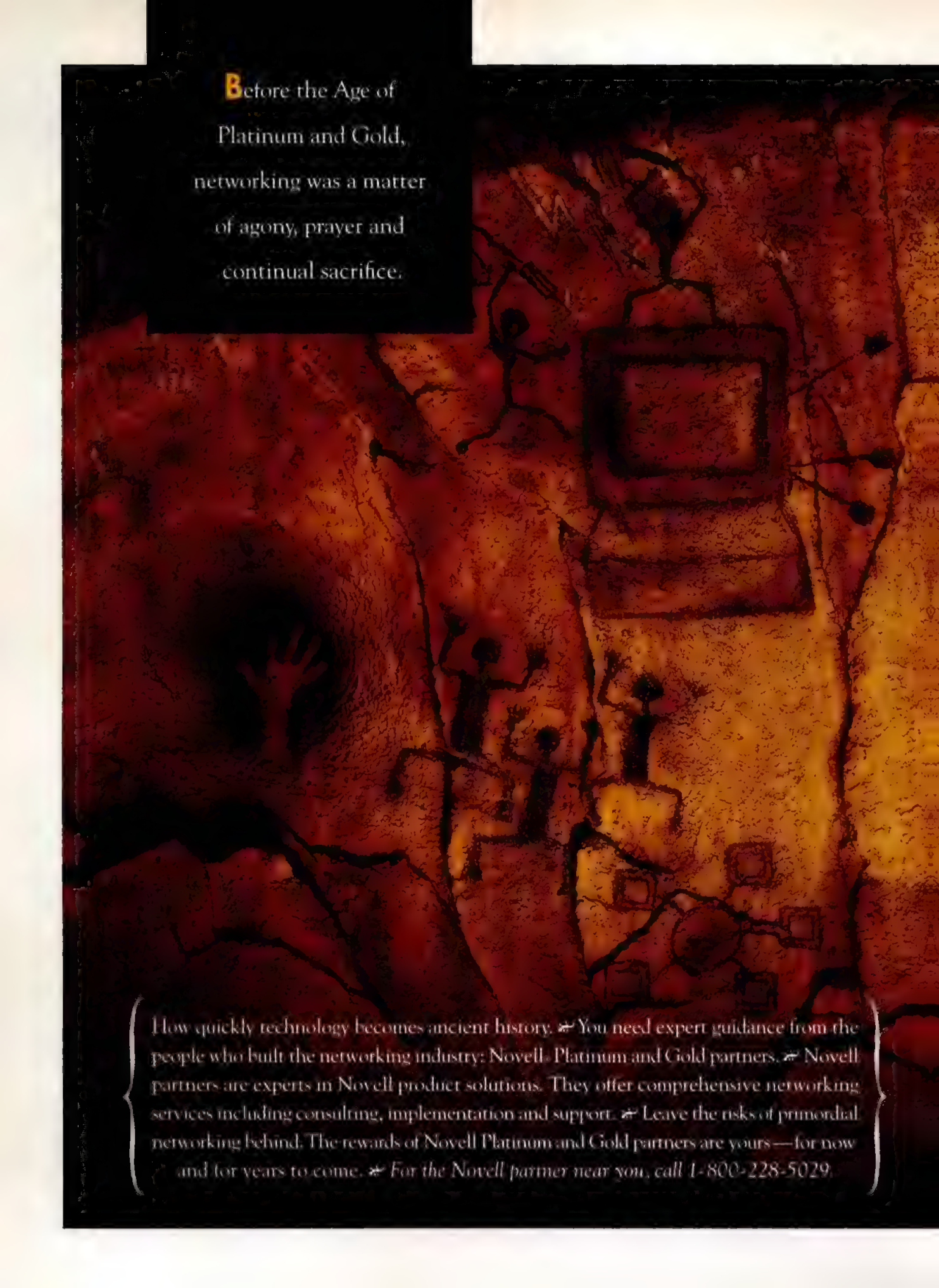
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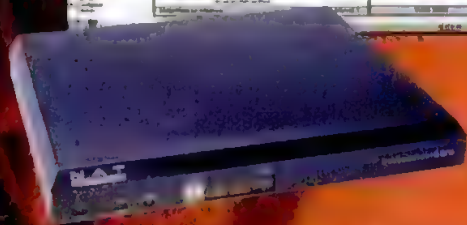
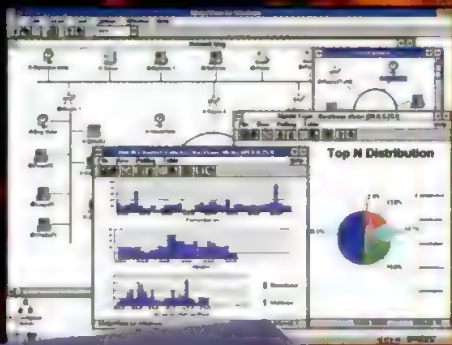
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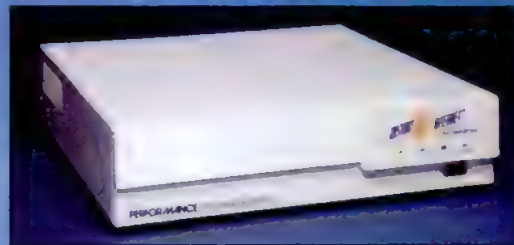
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PC Magazine, 5/90/95

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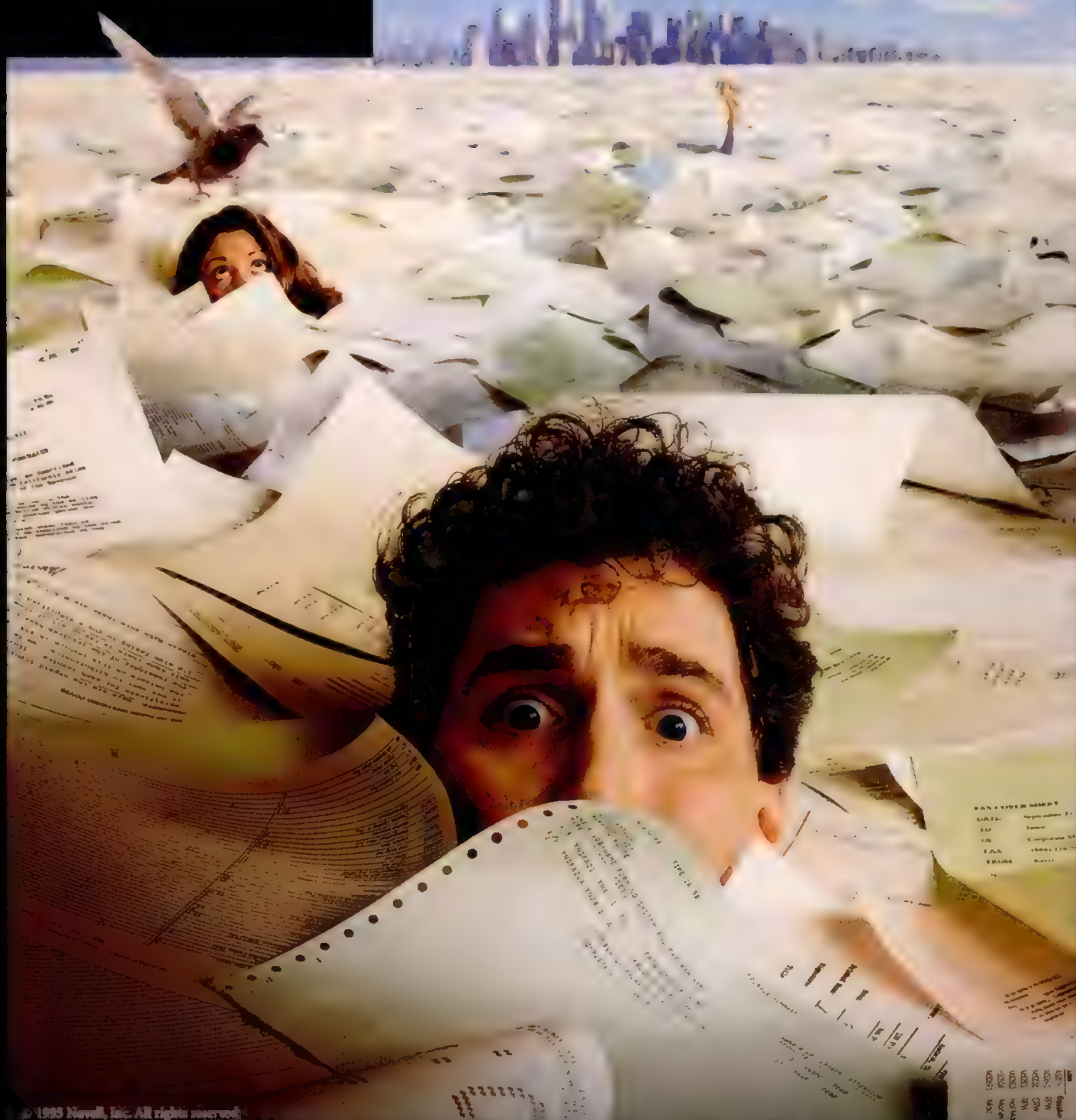
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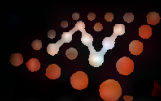
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A Pentium for



Pentiums? *Only* Pentium processors? You bet.

It's not that you can't find 486-based PCs any more; it's just that they don't really make much sense. When we began gathering machines for our annual roundup of essentially every mainstream PC on the market, we were struck by how limited current 486 offerings are. And we discovered that they are poor buys for almost every purpose. The move to Pentium-based PCs across the board—from what *PC Magazine* readers consider entry-level boxes all the way to high-end muscle machines—isn't just well under way; it's essentially complete.

In fact, market researcher Computer Intelligence InfoCorp says that sales of Pentium-based desktop and tower PCs surpassed sales of 486 machines for the first time in June of this year.

IT'S A 32-BIT WORLD (ALMOST)

Moreover, buyers of new PCs in this class are likely to keep them for a while. Given Intel's decision four years ago to focus the performance of the P6—the Pentium follow-up chip, now called the Pentium Pro—on strictly 32-bit software, today's Pentiums are likely to stay on desks longer than previous-generation PCs did.

Our migration to true 32-bit operating systems and applications has been much slower than Intel expected when it made that critical, early design decision: the company thought we'd be well into the 32-Bit Era by now. But even Windows 95, long hailed as a 32-bit answer, proved to be only partly 32-bit, and thus (as Intel admits) shows little performance improvement when running on Pentium Pro boxes instead of on today's fast Pentium PCs.

Buyers of today's new PCs are going to be living in a mixed 16-/32-bit world for some time, which

By Jim Seymour

Every Desktop



Whether you choose to blaze new computing trails with Windows 95 or stick with the tried and true desktop standard of Windows 3.x, your processor of choice will likely be a Pentium. PC Labs tests 103 Pentium-equipped systems running Windows 95 and Windows 3.x to help you decide.

means that purchasing anything less than a midrange to high-end Pentium-class processor is buying on the wrong side of the curve. The longer life cycle also means that buying the right Pentium box is more important now than ever.

THE THREE FACES OF PENTIUM

Intel's current Pentium offerings split roughly into three tiers. At the low end is the 75-MHz chip, still priced significantly less at the com-

ponent level than the next step up the CPU curve. Expect a Pentium/75 to remain a viable, inexpensive choice through at least the first half of 1996.

We define the midrange as 90- and 100-MHz Pentiums. But you'll notice from the reviews that follow that we received many more of the latter than the former. Not only are system prices very closely spaced, but with the 100-MHz chip you also get the added benefit of a faster bus speed (66 MHz versus 60 MHz).

RECENT REVIEWS

- **PowerPC: A Work in Progress**
October 24, 1995page 185
3 PowerPC machines compared with a 133-MHz Pentium PC.
- **Setting the Pace**
September 26, 1995page 183
66 133- and 120-MHz Pentium PCs.
- **Your Portable Persona**
August 1995page 102
80 color notebooks.

At the pinnacle of the Pentium hill you'll find 120- and 133-MHz processors. And as with the midrange, you'll notice that vendors sent many more Pentium/133s than Pentium/120s. Once again, pricing runs in favor of the buyer, and you'll also get a speedier bus with the faster CPU. You can look forward to new, even speedier Pentium designs—we expect 150-MHz and 166-MHz versions in January 1996.

WHAT TO BUY... AND WHAT TO TEST

Both Microsoft's delays in shipping Windows 95 and corporate buyers' reactions to the new operating system made our testing a little more complex than we'd expected. Many corporate buyers are delaying adoption of Windows 95 until at least next year, or are planning to leapfrog over Windows 95 to Windows NT. Either way, they're insisting that suppliers deliver new PCs preloaded with Windows 3.1 for now. Other corporate buyers, and the general PC market, are demanding Windows 95. Should PC Magazine Labs test machines with Windows 3.1 (or Windows for Workgroups 3.11), or with Windows 95? Or with both?

REVIEW CRITERIA

In the end, we decided to review machines preinstalled with Windows 3.1 and with Windows 95 separately—the former as what we tagged corporate PCs, the latter as general-purpose machines.

For both groups, we divided the hardware into two sections: midrange and high-end. For the midrange group we specified machines with Intel Pentium/90, Pentium/100, NexGen Nx586-P90, or Nx586-P100 CPUs; 16MB RAM (no more, no less); a 1GB or larger hard disk; a 3.5-inch floppy disk drive; a quad-speed CD-ROM drive; a 16- or 32-bit sound card with speakers; a monitor and graphics subsystem that support 1,024-by-768 resolution with 256 colors; and a mouse and a keyboard.

The high-end Windows 95 spec was identical but required PCs with Intel Pentium/120, Pentium/133, or equivalent NexGen CPUs.

For the Windows 3.1 (or Windows for Workgroups 3.11) group, we added network readiness—through on-board or add-in

Ethernet network interfaces—as a requirement. All but three of these machines used PCI NICs, for better performance; AT&T's lower-end Globalyst 630, the NEC PowerMate V100, and ZDS' Z-Station GT used ISA add-in NICs. Among the 17 other corporate PCs, the Compaq Deskpros, Dell OptiPlexes, and Digital Celebris GL 5100st offered PCI networking connections on the motherboard, while the other dozen boxes used a variety of PCI add-in NICs from Cogent, Digital, SMC, and 3Com.

We received 103 machines that qualified for PC Labs' tests. In the Windows 3.1 group we tested 20 machines, covered here in 10 reviews, including 11 high-end boxes and 9 midrange systems. In the Windows 95 group we tested a staggering 83 machines, covered in 49 reviews: 46 high-end boxes and 37 midrange PCs. Despite the interest in Pentium alternatives from other chip foundries, it's still an "Intel inside" world out there: We re-

ceived no machines using CPUs from other vendors.

BETTER DESIGN

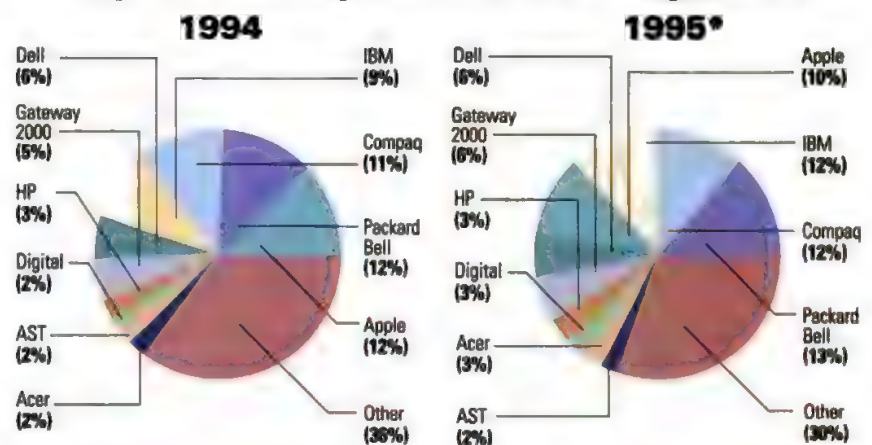
We were surprised and pleased by much of what we found. Today it's easier than ever to find a good PC—though perhaps harder than ever to find the *right* one. The quality of engineering is, across the board, better than we've seen in past years' large-scale comparative reviews. For example, only 2 of the 103 machines we tested did not use L2 caches to boost CPU performance. We consider L2 caches essential for getting the most out of Pentium CPUs, but in previous reviews we found many machines without second-level caches.

Part of the reason for the overall improvement in engineering is the growing use of Intel-produced motherboards. Intel began large-scale production of motherboards, with preinstalled CPU chips, about two years ago.

Some vendors screamed: By offering superior motherboard designs with the latest engineering innovations and the newest Intel support chips already installed, PC vendors such as Compaq—which relied on its own leading-edge design and engineering staff to get new PCs to market faster—would be at a disadvantage.

It was a fair complaint, from Compaq's perspective. Yes, newer technology and more advanced designs do make it to market more quickly, and are adopted and delivered much more widely, today, thanks to the Intel motherboards. But from the user's perspective, it's a clear win. Among the 103 machines tested, we found 25 Intel

Top Ten Desktop Vendors (U.S. Shipments)



* Projected.

Source: Computer Intelligence InfoCorp.

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Hard Drive	630MB or 1GB	630MB or 1GB	630MB or 1GB	1GB
Cache Internal	16KB	16KB	16KB	16KB
Cache External	256KB (optional)	256KB (optional)	256KB	256KB
Architecture	PCI	PCI	TriFlex/PCI	TriFlex/PCI
Video Memory/Max.	1MB/2MB	1MB/2MB	1MB/2MB	1MB/2MB
Compaq 150 Color Monitor	Yes	Yes	Yes	Yes
Diskette Drive	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB
Expansion Slots (Total)	3	3	4	5
Drive Bays (Total)	3	3	4	5
Ports: Serial/Parallel	1/1 (ECP)	1/1 (ECP)	1/1 (ECP)	1/1 (ECP)
Security Features	Yes	Yes	Yes	Yes
Processor Upgradable	Yes	Yes	Yes	Yes
101-Key Keyboard, Mouse	Yes	Yes	Yes	Yes
Software Preinstalled (Choice of)	MS-Windows® 95 or MS-Windows 3.1	MS-Windows 95 or MS-Windows 3.1	MS-Windows 95 or MS-Windows 3.1	MS-Windows 95 or MS-Windows 3.1
Energy Star Compliant	Yes	Yes	Yes	Yes
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motherboards. The move toward Intel motherboards has so far helped engineering quality and time-to-market mainly among smaller vendors; our Editors' Choice winners from Digital and NEC relied on proprietary motherboard designs developed in-house. And the latest technology, including the newest Intel chip sets for Pentium CPUs, certainly isn't

found only on Intel motherboards. The current Intel Triton chip set was found on an overwhelming 87 of the 103 machines we reviewed, on motherboards from about 20 makers in addition to Intel.

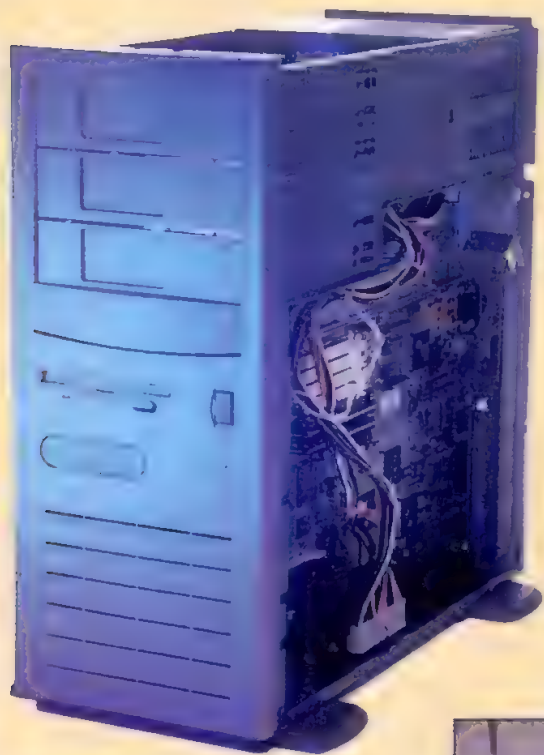
BETTER COMPONENTS

We saw premium-quality parts in many more machines than in years past. Fast,

high-quality video cards from ATI, Diamond, Matrox, and Number Nine, for example, were standard in most machines tested; the speedy Diamond Stealth 64 card was by far the most common. And several vendors went all the way, putting 4MB of video RAM on-board, though 2MB is sufficient for most purposes.

All but 11 PCs support the latest En-

PICKS AND PANS *The 103 Pentium PCs we tested for this story offered lots of great*



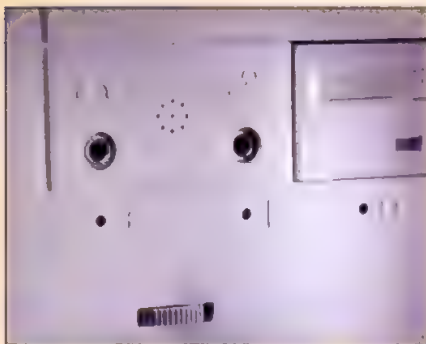
COMPAQ PROLINEA 5100

Easy Access: This compartmentalized, easy-to-open case provides quick access to all internal components such as drive bays and expansion card slots.



PERCOMP P133 PROFESSIONAL

Here's our idea of a well-stocked PC: It has two quad-speed CD-ROM drives, a Colorado T-1000 tape drive, and a V.34 fax modem.



TANGENT MEDIASTAR 5133/95

Accessible Multimedia: All the systems we tested had sound, but this one puts it right at your fingertips: Built-in speakers, microphone and headphone jacks, MIDI port, and amplifier and bass controls are all conveniently located on the front of the case.



hanced Parallel Port/Extended Capabilities Port (EPP/ECP) specs; we think the potential for higher-speed parallel-port transfers, with Windows 95's Direct Connect feature and the new active-electronics cable from Parallel Technologies, will be an important issue for many buyers.

We also saw evidence of how strongly the Enhanced IDE (EIDE) and Fast-

ATA hard disk interfaces have moved to center stage for high-performance PCs. Only eight of the machines we tested used some form of SCSI interface; all the rest relied on EIDE/Fast-ATA. Not long ago putting any flavor of IDE interface in machines as fast and powerful as these would have been unthinkable, but drives built to the newer, more robust EIDE/Fast-ATA

specs have shown that they can meet the performance requirements of fast Pentium PCs, as well as save money over SCSI.

SCSI is still the interface of choice for absolute-performance machines, and for those PCs to which you'll probably add a string of SCSI-only peripherals such as flatbed scanners, slide scanners, and opti-

features, and a few that weren't so great.



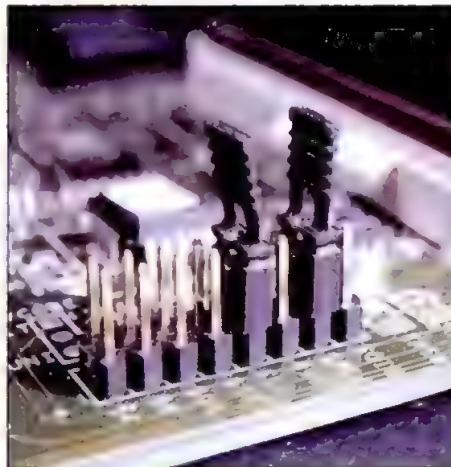
NEC POWERMATE V100

Color-coding: NEC makes setup very easy with color-coded cables that match the colored icons on the back of the case. You're set up and ready to roll in a matter of minutes.



DIGITAL CELEBRIS GL 5120st

Thumbscrews: We especially liked Digital's implementation of thumbscrews on the Celebris GL 5120st. Not only are they big and easy to turn, but they stay attached to the case after the cover comes off, so you'll never lose them.



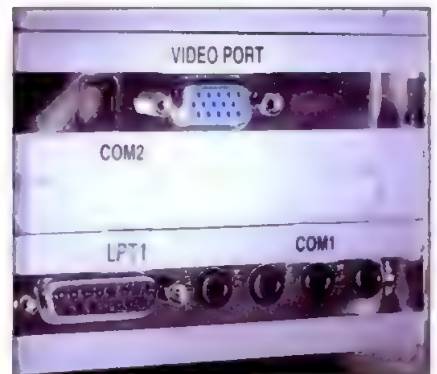
DELL OPTIPLEX GXMT5133

Get a grip: Dell provides handles on each of its jumpers and device cables, making them easy to insert or remove.



AT&T GLOBALYST 630

PCMCIA: This unit's built-in PCMCIA drive is a great feature, especially if you're a notebook-toting road warrior who transfers files back and forth frequently. But the drive is inconveniently located on the back of the machine.



TANGENT MEDIASTAR 590/95

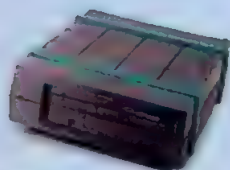
Misled: Labeled ports are a great idea, but don't try to use these as a setup guide—some are mislabeled and won't get you very far.

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SCSI Host Adapter Bus Master	Adaptec 1535	AdvanSys	None	None
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Windows 95 32 bit mode included	Yes	No	No	No
Windows NT 32 bit mode included	Yes	No	No	No
Microsoft MS Backup compatibility included	Yes	No	No	No
Kodak PhotoCD creation software included	Yes	No	No	No
Audio Editing utility included	Yes	No	No	Yes
Disc at Once recording software included	Yes	No	No	Yes
Caddy based system	Yes	No	Yes	Yes

Source: pricing and information obtained directly from manufacturers on 10/18/95

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Reliability Better than average

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The **repair** rating is a measure of respondents' satisfaction with the repair service provided by the vendor for machines in use over the past two years.

The **percent needing repair** rating is a measure of the proportion of machines that respondents indicated needed repair in the first year of use.

cal disk drives, to name just a few. But overall, the economies of the now nearly ubiquitous EIDE interface are persuasive for both buyers and sellers.

The choice of EIDE hard disk interfaces was also confirmed—and perhaps to some degree driven, as well—by the quad-speed EIDE CD-ROM drives installed in these machines. But a few vendors installed SCSI-interface CD-ROM drives in machines with EIDE hard disk interfaces. For those who may eventually want both interfaces (say, for an external SCSI-device chain), that can save money. But if you're counting on adding SCSI devices to a PC with an internal SCSI CD-ROM, make sure the SCSI card controlling that CD-ROM is ASPI-compatible, or you may have trouble finding drivers for those additional devices. Also make sure the SCSI controller is SCSI-2 or Ultra-SCSI. The latter, a 40-MBps extension of the SCSI spec, is likely to handle any expansion needs until the next generation of serial-expansion-bus architectures take over.

EASY EXPANSION

Any PC bought today should provide a flexible platform for future expansion—to allow easy addition of more memory, more storage devices, and more expansion cards and to let you update the system's BIOS as needed to accommodate those expansions and new developments in software. These PCs do well in all four areas.

These machines are generally well-designed for user-installed storage devices as well. For more hard disk space, internal bays are fine; for optical disk drives, single or multidisk CD-ROM players, CD-R recorders, tape backup devices, ZIP and SyQuest cartridge drives, PC Card-slot

(formerly PCMCIA) drives, and other removable-media devices, external access is required. Additional hard disks installed in internal bays are almost always 3.5-inch devices these days, so 5.25-inch internal bays are unneeded. But most of the devices you're likely to install in external-access drive bays will require the wider 5.25-inch slot, so make sure the PC you're considering has sufficient 5.25-inch externally accessible drive bays.

BIOS upgradability is important, too. Flash BIOS design, which allows you to update your machine's BIOS chip by running a program from a floppy disk, makes it easy. Among the PCs we tested, only the two Tatung PCs did not use a Flash BIOS.

THE WINDOWS 95 EFFECT

Sales of these new Pentium systems are clearly benefiting from the appearance of Windows 95. In general we've been pleased, and even a little surprised, at the backward compatibility of Windows 95, including its Plug and Play features. However, installing Windows 95 on a few hundred older PCs has persuaded us that the best—

and certainly the easiest—way to take advantage of its benefits is to start afresh with a new PC preloaded with (and at least theoretically optimized for) Windows 95.

Moreover, the cost-effectiveness of upgrading an older machine versus investing in one of these new Pentium machines is questionable. Assuming an older PC needs at least 12MB of RAM, a new 1GB hard disk, a quad-speed CD-ROM drive, and a new video card to come close to these machines it's easy to spend a significant chunk of the cost of one of these new models on upgrading what will still be an aging PC.

We think 100-MHz and especially 133-MHz Pentium machines are going to be desirable, highly capable PCs for years to come, unlike some other recent generations of new PCs. Even if the move towards full-32-bit software accelerates, the performance gains of the first generation of P6/Pentium Pro PCs are unlikely to be compelling.

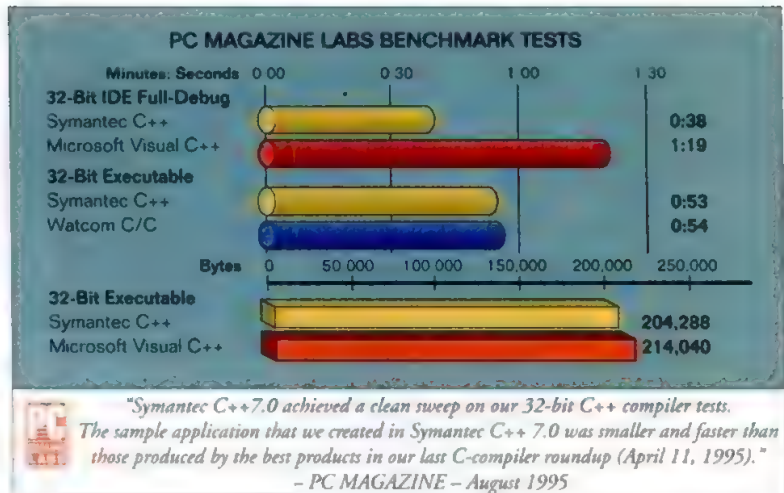
In sum, we think you can find a Pentium PC for nearly every desktop in this group. With street prices starting under \$2,000 for these powerful configurations, these machines demonstrate very well how thoroughly Pentium power has taken over the PC marketplace. And why, if you're in the market for a desktop PC right now, your best choice is likely to appear in the following pages. □

Our Contributors: JIM SEYMOUR is a contributing editor of PC Magazine. WILLIAM P. FLANAGAN is a staff writer and ROBERT ANTHONY is a senior writer at PC Magazine. BRUCE BROWN and JOHN R. QUAIN are contributing editors of PC Magazine. MARY E. BEHR is a staff editor of PC Magazine. RICHARD FISCO is a project leader at PC Magazine Labs. CAROL VENEZIA was the associate editor in charge of this story, and ALEX HO was the project leader.

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WINDOWS 95 MACHINES

In like a Lion...

After months of hype, Windows 95 has arrived. Was it worth the wait? We put 83 Windows 95-based PCs through their paces to find out.

By Robert S. Anthony

If nothing else, the long-awaited arrival of Windows 95 has injected new vitality into otherwise boring PCs. PC buyers can now look forward to a tidal wave of glitzy Windows 95 applications and sophisticated new hardware to play with. All this comes as a great relief, given the hype accompanying Windows 95.

While we can't say that the task of reviewing the latest Pentium PCs had evolved into terminal boredom, a touch of tedium had made its way into our PC review routine. In previous Pentium roundups, we had become accustomed to seeing the same thing: beige boxes with MS-DOS and Windows preinstalled on the hard disk. Even some of the programs, such as Microsoft Encarta, left us a bit jaded since we've seen them about as often as we've seen the Windows Solitaire icon.

In came Windows 95 to the rescue. For the first time since 1992, when Windows 3.0 was introduced, we had a fresh, new, widely accepted operating system to dig our teeth into. Not only did the presence of Windows 95 affect the software that came with the machines in this roundup, but its new features—such as Plug and Play support—gave vendors good reason to take a long look at the hardware inside their machines as well.

As we began testing these PCs,



► IN THIS REVIEW

Vendors of products reviewed:

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we weren't sure if we'd end up spending long nights deciphering Windows 95 error messages or watching the units hum along effortlessly with their new OS. Quite frankly, we were fired up. Although we did encounter some glitches along the way—an expected occurrence when you're testing 83 PCs—for the most part these systems took well to their new environment.

REALITY BYTES

The task of acquiring 83 Windows 95-equipped Pentium PCs for testing was a mammoth undertaking in itself. Add to that the job of testing each PC under a brand-new operating system, using benchmark tests that were finalized lit-

erally hours before the machines started to arrive at PC Labs West Coast, in Foster City, California—and you had something akin to the stress tests that the U.S. Air Force gives to new fighter pilots. Somehow it all worked.

Since Windows 95 debuted just before we began testing, some vendors could not ship units with Windows 95 preinstalled. In such cases, we installed Windows 95 ourselves and used default parameters where necessary.

This meant that many vendors did not have a chance to fine-tune their PCs for optimal performance under Windows 95. Even in cases where vendors did send us PCs with Windows 95 installed, chances are good these machines will undergo

hardware and software upgrades by the time you read this. Many graphics board drivers originally bundled with Windows 95, for example, have already been superseded. Indeed, the most useful component on a new Windows 95 PC may well be the modem, since it allows users to start downloading new drivers from vendors' bulletin boards immediately.

REVIEW CRITERIA

For this roundup, we required machines with Pentium-level processors, 16MB of RAM, minimum 1GB hard disks, a quad-speed or faster CD-ROM drive, and a graphics card and monitor that supported 1,024-by-768 resolution with 256 colors at 75 Hz.

HIGHLIGHTS

Pentium PCs Running Windows

Windows 95 has arrived, and the scramble has begun for more powerful and more exciting hardware than we've seen for quite some time; in short, lots of neat new toys to play with. This new operating system should be the shot of adrenaline that the oftentimes bland, beige PC world needs.

EXPECT MORE FOR LESS

when you shop for a new PC. Today, you can purchase a fully equipped, top-performing 133-MHz Pentium

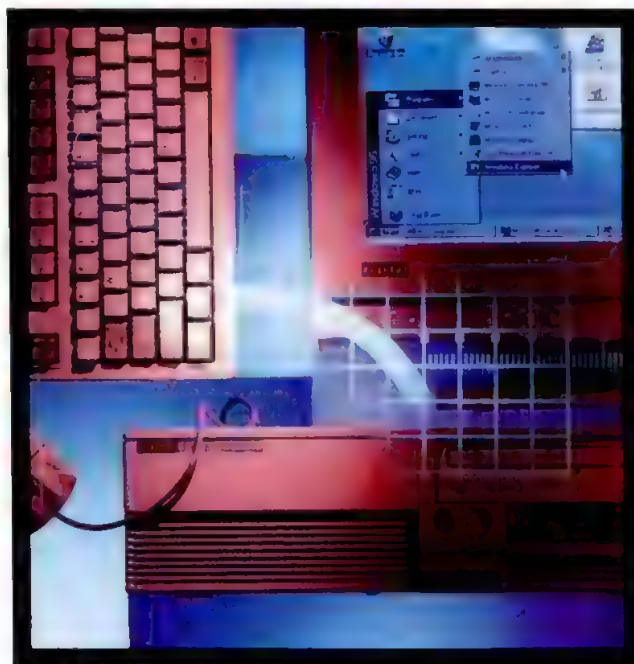
system for well under \$4,000. Prices of the machines reviewed here averaged about \$3,600 for a high-end system and \$2,900 for a midrange PC.

GREAT PERFORMANCE

comes from well-tuned subsystems. We found through testing that PCs equipped with synchronous or pipelined-burst external processor cache, EDO DRAM, speedy hard disks, and 64-bit high-end graphics accelerators outperformed lesser-equipped systems across the board.

OUR TESTS SHOWED Windows 3.x systems outperforming Windows 95 machines on almost every measure, especially on our Winstone 96 and Disk WinMark 96 tests. The one exception? Graphics WinMark 96: On this test, the Windows 95 PCs soundly trounced Windows 3.x systems. It appears that Windows 95's 32-bit DIB engine and universal drivers are able to deliver better performance than Windows 3.x's 16-bit drivers, which in most cases have already been tuned for the best performance.

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We define two classes of PCs in this review: high-end (120-MHz and 133-MHz Pentiums) and midrange (90-MHz and 100-MHz Pentiums). We had hoped to get Pentium-class systems with Nex-Gen or Cyrix CPUs, but none arrived. Of the 38 midrange PCs, 7 had 90-MHz processors and 31 had 100-MHz processors. Of the 47 high-end units, 5 used 120-MHz processors and 42 used 133-MHz processors.

AMONG THE MISSING

Several vendors declined to participate in this roundup for a variety of reasons. Among these vendors were Acer America Corp., AST Research, IBM Personal Computer Co. (IBM's PC 300 system is reviewed in this issue's Windows 3.x roundup), and ZEOS.

HARDWARE TRENDS

While we saw many different types of motherboards in the reviewed PCs, nearly all of them were built around an Intel Triton chip set. In our recent reviews of Pentium machines, we found that the performance of the Triton chip set was superior to that of chip sets from other manufacturers.

On the graphics side, 43 of the machines used Diamond Multimedia graphics boards. The favorite, used in 31 units, was the Diamond Stealth64 Video VRAM card. However, the five Pentium/133 PCs outfitted with the Matrox Millennium board (which has the new Window RAM) were the ones that logged the best Graphics WinMark 96 scores in this roundup.

Unlike Windows 3.11, Windows 95 offers effective support for networking. Accordingly, 14 of the PCs reviewed here came with network interface cards. When used with the new wave of Plug and Play NICs, Windows 95 provides a quick-and-dirty but sufficient networking solution for small offices.

Since Windows 95 lets you cram more icons and other information onto each screen, the larger the monitor you have access to, the easier it is to work with Windows 95. In this roundup, 33 of the 83 PCs came with 17-inch monitors. The rest had 15-inch monitors, except for three units that came with smallish 14-inch monitors.

Midrange:

Dell Dimension P100t

High-end:

Dell Dimension XPS P133c

Finding any PCs that stand out from a crowd of 83 is a difficult chore at best. Not only must they be top performers, but they must also provide a great set of features—and do it all at a competitive price. Our

two Editors' Choice Windows 95-based Pentium PCs, both from Dell Computer Corp., are shining examples of what this award is all about.

For our midrange Editors' Choice, we selected the \$2,378 Dell Dimension P100t. This machine may be one of the lowest priced PCs in this roundup, but it's definitely not low on features or performance. Using a well-integrated set of top-notch components—including a 5,400-rpm Quantum Fireball hard disk and 256K of pipelined-burst cache—the Dimension P100t garnered scores on our Windows-based benchmark tests that were not only among the highest in its CPU class but also rivaled scores posted by many of the Pentium/133 systems as well.

Our favorite high-end PC, the \$3,698 Dell Dimension XPS P133c, easily captured our second Editors' Choice award. This machine, which represents the top of Dell's performance-oriented Dimension XPS line, squarely meets the needs its target audience of power users. Like the Di-

mension P100t, this system stacked up well against the competition on our performance tests. And it also packed a lot of bang for the buck, including a

17-inch monitor, a 1.5GB Enhanced IDE hard disk, 4MB of VRAM on its Number Nine graphics accelerator card, and a sextuple-speed ATAPI CD-ROM drive.

We also found two machines in this field of 83 that merited an honorable mention: the high-end NEC PowerMate P133 and the midrange Digital Celebris GL 5100st.

Priced at \$3,278, the Celebris GL 5100st is not only a great performer but one that offers some compelling features, including a 1.5GB hard disk, EDO DRAM, and a three-year parts-and-labor warranty with one year of on-site service.

The \$3,778 DMI-compliant NEC PowerMate P133 offers the same great warranty terms and big hard disk. It sweetens the deal further by adding a 6X CD-ROM drive. Easy setup is accomplished via color-coded cables and a quick-start guide.



MULTIMEDIA BENCHMARK TESTS DEBUT

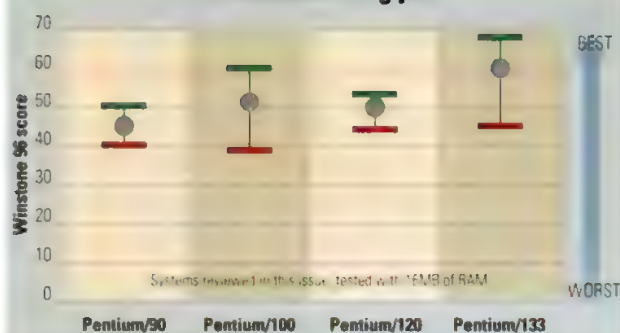
This group of machines was the first to be tested with our new series of benchmark tests, which includes tests to gauge your computer's multimedia prowess. Consisting of a mix of video and audio throughput tests, the CD-ROM WinMark 96 test suite yields a score that offers a good indication of which PCs will play video files without losing frames or chopping up the audio output. We also introduced other new tests to gauge var-

ious aspects of video playback quality.

Most of the machines reviewed here were equipped with quad-speed CD-ROM drives. Sextuple-speed drives from Plextor, NEC, and TEAC, however, were seen on 11 of the systems.

In the following pages, you'll find reviews of 83 Windows 95-equipped Pentiums from 49 vendors. Whether you're looking for a 133-MHz speed demon or a more budget-conscious, 100-MHz machine, chances are you'll find it here.

System Performance by Processor Type



Aberdeen Inc.

Aberdeen P133-PCI

The \$3,395 133-MHz Pentium Aberdeen P133-PCI is a solid choice. It ships with a strong selection of components and yielded midrange scores on our performance tests. Aberdeen sells direct and through dealers, offering custom configurations of high-performance PCs for demanding graphics applications.

Based on a Super Micro motherboard and Intel Triton chip set, the Aberdeen also featured EDO DRAM and 512K of pipelined-burst external cache.

The system's average score on the Graphics WinMark 96 test was aided by its Diamond Stealth64 Video VRAM graphics card, which runs on S3's Vision968 graphics chip set.

A 1.6GB Western Digital IDE hard disk helped it garner an average Disk WinMark 96 score. The Aberdeen system also posted average Winstone 96 and multimedia test scores.

It's easy to get into the Aberdeen: The system's tower case has swing-out side panel access doors. The emphasis on comfort and ease of use continues with the use of the Microsoft Natural Keyboard and a 17-inch Tatung monitor. In order to get the best sound from the

parts-replacement policy. Four years of on-site service (which is not available for the first year) costs \$229.95 more.—Bruce Brown

Aberdeen Inc., Santa Fe Springs, CA; 800-552-6868, 310-801-5626; fax, 310-801-5629.

Circle 475 on reader service card

ACMA Computers Inc.

ACMA z-Power100, ACMA z-Power133

ACMA Computers' z-Power PCs come with a full complement of great components, including modems and 17-inch monitors. Considering these components, the \$3,295 midsize tower z-Power100 and \$3,595 tower z-Power133 are well priced. Both were average or better performers on all our benchmark tests. Sold mostly direct, the ACMA machines target the corporate market, Windows power users, and the small-office/home-office market.

Both ACMA systems came loaded with EDO DRAM, 256K pipelined-burst external cache, Quantum 1GB hard disks, and Diamond Stealth64 Video VRAM cards with 4MB of VRAM. The systems also include 17-inch MAG Innovision monitors, 28.8-Kbps data/fax modems, NEC 6X CD-ROM drives, Altec Lansing ACS5 speakers, and Microsoft Natural Keyboards. A Creative Labs Vibra 16S audio chip that supports FM synthesis is integrated on the motherboard.

The z-Power100 had above-average Winstone 96 and Disk WinMark 96 scores and an average Graphics WinMark score. The z-Power133 also performed well, with an above-average Disk WinMark score, and average Winstone and Graphics Win-

Mark scores.

The software that came with both of the ACMA systems included Microsoft Works, Microsoft Encarta 95, Best of Microsoft Entertainment Pack, and Fax-Works with communications software.

The ACMA systems come with a one-year warranty on parts and labor, on-site support included. Technical support is available during weekday business hours, PST.—BB

ACMA Computers Inc., Fremont, CA; 800-786-6888, 510-623-1212; fax, 510-623-0818.

Circle 476 on reader service card

All Computer Warehouse

ACW Pentium P5-133B

The \$2,604 ACW Pentium P5-133B is the lowest-priced machine in the 133-MHz class. The company doesn't skimp on hardware, software, or performance, making this is a machine to consider. All Computer Warehouse configures systems for corporate desktops, selling through dealers and distributors. ACW also offers two Pentium/120 versions of this machine: one for the business user and one for the home-business user, differentiated by the included software.

The midsize tower ACW uses an ASUSTek motherboard with an Intel Triton chip set. EDO DRAM and 512K of pipelined-burst external cache are also on board. A Seagate 1GB hard disk helped the system achieve an average Disk WinMark 96 score, and an S3 Vision968-based Diamond graphics card with 2MB of VRAM figured in the system's average Graphics WinMark 96 score. This unit's Winstone 96 score was average as well.

Other hardware bundled with the ACW Pentium P5-133B includes a 15-inch Proton monitor, Toshiba quad-speed CD-ROM drive, Creative Labs Vibra 16S 16-bit audio card (FM synthesis only), and



IN SHORT

A good hardware bundle and good performance set these systems apart.



IN SHORT

This 133-MHz system offers good performance at an appealing price.

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CIRCLE 304 ON READER SERVICE CARD

Windows 95 Multimedia Enhancements

By Richard Fisco

Do your video clips drop so many frames that it looks as if you're watching an old Charlie Chaplin movie?

Why can't your PC's video be more like your TV? Don't give up on it just yet. Microsoft Windows 95 could be just what you have been waiting for.

WHERE WE ARE TODAY

Windows 3.x PCs need tuning and driver support to run video. To access your CD, you will need a CD-ROM driver that can take from 10K to 20K of conventional memory. Next, you'll need MSCDEX, which can take up to 35K of conventional memory.

But wait: You're not finished if you want to get decent performance from your CD-ROM drive. You'll need to load SmartDrive, Version 5.0 (the first version to support CD-ROM caching), to cache your CD. SmartDrive itself can take up to 30K of conventional memory. You've now just forfeited 75K to 85K of conventional memory (or upper memory blocks when using memory managers) just to get your CD-ROM drive running.

Of course, memory managers like Quarterdeck's QEMM can help get that memory back, but if you add in network drivers, you're back to where you started: in need of memory. Finally, to have this working correctly you must load the CD-ROM driver and MSCDEX *before* loading SmartDrive so the CD-ROM can cache.

Now that your CD-ROM is up and running, you'll need graphics. You'll need a fast graphics card and a video codec to run your video. In Windows 3.x all these features were built on 16-bit code. And codecs such as Indeo and Cinepak are also 16-bit. Windows 95's graphics drivers and codecs are 32-bit, and the added speed they bring can smooth out video-clip formats.

WINDOWS 95: CDFS, VFAT, AND VCACHE

With Windows 95, Microsoft introduces the virtual CD-ROM file system

(CDFS). This 32-bit protected-mode file system provides better CD-ROM performance over MSCDEX in Windows 3.x.

The 32-bit Virtual File Allocation Table (VFAT) system is the primary file system and cannot be disabled. VFAT handles all hard disk requests, using 32-bit code for all file accesses.

*No more tweaking
virtual memory—
Windows 95 does it
automatically.*

CDFS has the same responsibilities for a CD-ROM drive as VFAT has for a hard disk.

Some benefits of CDFS include better multitasking when accessing CD-ROM information, and dynamic cache support to provide a better balance between memory for running applications and memory for caching. Both VFAT and CDFS run in the protected mode of x86 processors.

Along with CDFS comes a caching system, VCACHE, which is similar in function to SmartDrive, but is a 32-bit protected-mode cache driver with an improved algorithm. VCACHE is not limited to 2MB, as is SmartDrive, and dynamically shares the cache memory pool with VFAT.

The days of tweaking your virtual memory are over. Windows 95 handles allocation of cache to the CD-ROM and hard disk automatically. CDFS can read ahead in parallel with the application, making for smoother video-clip playback. The CDFS cache is separate from hard disk cache, which allows it to be swapped out to the hard disk. The benefits of this system are evident when it is running a large video stream. Main memory (cache) is by far the fastest to read from. But it would still be faster to read from a CD cache

that has been swapped out to a hard disk rather than read from the CD-ROM drive itself, which is the slowest link in this trio.

VFAT also supports lazy-write (write-back) throughput. Lazy-write allows applications to write immediately to the cache, while VFAT will wait to write that information to the disk later, when the disk isn't busy.

VIDEO DRIVERS AND CODECS

The last pieces of the puzzle are the video-card drivers and codecs. Windows 95 uses protected-mode 32-bit drivers for both (while Windows 3.x uses 16-bit drivers).

Windows 95 ships with three codecs: Radius's Cinepak, Version 1.8.0.12; Intel's Indeo R3.1 and R3.2; and Microsoft's Video 1. The 32-bit drivers are a big improvement over Windows 3.x's 16-bit drivers and result in better video performance.

Windows 95's 32-bit graphics drivers have also changed significantly from Windows 3.x implementations. Windows 95 includes a minidriver/universal-driver technology for display drivers. These universal drivers use a device-independent bitmap (DIB) engine, which provides 32-bit graphics code and supports all in-memory graphics operations and on-screen operations that do not pass to the graphics adapter for acceleration. In combination with a universal display driver, the minidriver supports only hardware-specific instructions. Together, the minidriver, universal driver, and DIB engine provide better graphics performance than Windows 3.x.

Minidrivers are available for most leading graphics chip manufacturers. They work with the DIB engine to provide optimal performance. Soon many graphics card vendors will have implemented Microsoft's new Direct-Draw compatibility into their drivers to allow Windows 95 to detect and use specific video-acceleration features of the graphics card.

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CIRCLE 353 ON READER SERVICE CARD

Windows 95 Machines



IN SHORT

This unit offers average performance for a surprisingly low price.

one-year parts-and-labor warranty. One year of on-site service is an additional \$109.95.—BB

All Computer Warehouse, City of Industry, CA; 800-775-1953, 818-369-4181; fax, 818-961-7462.

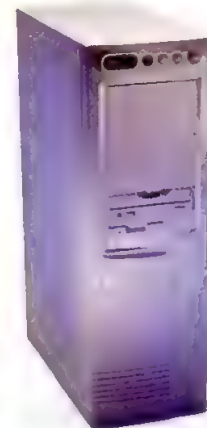
Circle 477 on reader service card

AMAX Engineering Corp.

AMAX P100 Powerstation, AMAX P133 Powerstation

You get a lot for your money with AMAX PCs. The \$3,005 AMAX P100 Powerstation and \$3,844 AMAX P133 Powerstation are solid performers in their respective classes and come loaded with today's hot components. The AMAX Engineering PCs, available direct as well as through resellers and distributors, target the corporate market as well as the small-office/home-office market.

Both computers come in full-tower cases and are based on Intel Endeavor motherboards with Intel Triton chip sets. Both have 256K of pipelined-burst external processor cache and EDO DRAM, as



IN SHORT

Both units are well-priced systems with 6X CD-ROM drives and modems.

60-watt MLI 691H speakers.

Software bundled with the ACW system was more appropriate for the small-office/home-office market than for mainstream corporate users. Titles included Microsoft Works, Microsoft Encarta 95, Microsoft Money, and the Microsoft Entertainment Kit.

All Computer Warehouse offers a

well as 1.2GB Western Digital Caviar hard disks and Diamond Stealth64 Video VRAM graphics cards with 4MB of VRAM. Both also have MAG monitors: a 15-inch model for the P100 and a 17-inch for the P133.

The P100 had average Disk WinMark 96 and Winstone 96 scores and an above-average Graphics WinMark 96 score. The P133 was on a par with the competition on our Graphics WinMark and Winstone tests, but posted a below-average score on the Disk WinMark test.

A Creative Labs Vibra 16S audio chip with FM synthesis is integrated on the motherboard. AMAX also includes an NEC sextuple-speed CD-ROM drive, Altec Lansing ACS5 speakers, and 28.8-Kbps data/fax modems. Both machines came with Microsoft Works, Microsoft Encarta 95, and FaxWorks with communications software.

The only weak link is the warranty: Parts and labor are covered for only one year, with on-site service available at \$49 for the year.—BB

AMAX Engineering Corp., Fremont, CA; 800-800-6328, 510-651-8886; fax, 510-651-4119.

Circle 478 on reader service card

AT&T Global Information Solutions

AT&T Globalyst 630

AT&T has a winner with the Globalyst 630. Priced at \$3,250, this system performed on par with its competition on our benchmark tests. The design takes into consideration future expansion, putting it among the elite in the 100-MHz processor group. AT&T also sells the Globalyst 730 (covered in the Windows 3.1 story in this issue), an advanced system with upgraded video and integrated SCSI support. Unfortunately, as we were producing this story, AT&T announced its breakup, and that it will no longer sell desktop PCs.

The minitower Globalyst 630 has a unique design: The front-accessible drive cage is removable and can be flipped on its side and reinserted, so you can use the machine as a desktop PC. The motherboard has an integrated S3 Trio64 graphics chip set, as well as 256K pipelined-burst cache installed. Peripherals include a Creative Labs sound card, a pair of Bell Labs

speakers, and an integrated microphone.

The Globalyst's Disk WinMark 96 score was average within the 100-MHz group, due in part to a 1.5GB hard disk. Its Graphics WinMark 96 score was average, as was its Winstone 96 score.

The 630 comes with Vistium Share software, Network Central, and Mail Flash, which can forward text messages to someone else's pager.

AT&T offers a three-year warranty on parts and labor, which includes one year of on-site service.—William P. Flanagan

AT&T Global Information Solutions, Dayton, OH; 800-447-1124, 513-445-5000.

Circle 466 on reader service card



IN SHORT

Solid performance, good design, useful software: This is one to consider.

SERVICE & RELIABILITY

AT&T OIS

Reliability	Worse than average
Repair	Average
Technical support	Average
Percent needing repair	Average

Compaq Computer Corp.

ProLinea 5120, Deskpro 5100, Deskpro XL 5133

The \$3,524 ProLinea 5120; the \$3,542 Deskpro 5100, Model 1080/w; and the \$5,267 Deskpro XL 5133, Model 1050/w, are all PCs aimed at corporate buyers with different levels of computing needs. The desktop ProLinea 5120 is an entry-level business PC; the Deskpro 5100, which features an innovative and easy-to-service new case design, is aimed at mainstream networked corporate users; and the top-of-the-line Deskpro XL desktop targets networked power users. Compaq also markets the Presario line of systems for small-office/home-office users.

Though one of the requirements for this roundup was audio support, Compaq sent its Deskpro 5100 and ProLinea 5120 units with no sound capabilities. The Deskpro XL 5133 features Compaq's Business Audio, powered by an integrat-

THE TI EXTENSA 550CD. AT ITS PRICE, THE ONLY THING THIS MULTIMEDIA POWERHOUSE DOESN'T HAVE IS COMPETITION.

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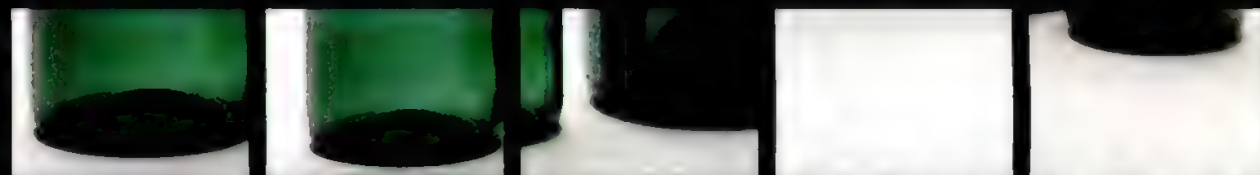
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IN SHORT

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ed 16-bit sound chip. Both Deskpros have on-board Ethernet, augmented by network setup help in the Compaq Control Center. The EISA/PCI-based Deskpro XL 5133 is built around Compaq's TriFlex/PCI architecture. There were only two drive bays free in this desktop case after the floppy disk drive, hard disk, and quad-speed CD-ROM drive were installed. But this unit included a 17-inch

monitor and a Matrox graphics controller with 4MB of VRAM.

The Deskpro XL had difficulty keeping pace with the competition on our benchmark tests. A 2GB SCSI-2 hard disk helped it post an average score on the Disk WinMark 96 tests, but its Graphics WinMark 96 score was below average and its Winstone 96 score was one of the lowest in its CPU group.

The ProLinea 5120 was a competitive performer in its class, posting an average Winstone score. In fact, its score was slightly higher than the Deskpro XL 5133's score. The unit's Disk WinMark score was average also, but its Graphics WinMark score was slightly below average.

The network-ready Deskpro 5100 mini-tower boasts one of the most impressive designs we evaluated in this roundup. The top cover comes off to expose the drive bays, and two side panels swing out to reveal the motherboard on one side and expansion slots and connectors on the other.

The Deskpro 5100's Graphics WinMark and Winstone scores were average; its Disk

WinMark score was below average.

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The great thing about this "dream machine" is that you can make it a reality. Comtrade's \$3,095 P5/133 Multimedia MPEG Dream Machine is a worthy system with better-than-average Windows applications performance and an affordable price. This machine targets the small-/home-office market; Comtrade also has a midrange line, the Hyperspeed MPEG Multimedia.

IN SHORT

Finally, strong Windows performance at an affordable price.

Windows 95's Memory Sweet Spot

By Richard Fisco

Are you are afraid to upgrade to Windows 95 because you think it needs so much more memory than Windows 3.x? Don't be. Our tests show Windows for Workgroups 3.11 is slightly faster than Windows 95 at 8MB and even at 16MB. Our testing was done with our new benchmark test suite, Winstone 96, which uses all 16-bit apps, so we expect performance under Windows 95 to increase when 32-bit applications become ubiquitous.

Now the bad news, which isn't that bad. If you are running Windows for Workgroups with 4MB of RAM, then you will have to upgrade to at least 8MB. We did not test Windows 95 with 4MB of RAM because Microsoft recommends 8MB, and Winstone will not run with 4MB.

Upgrading from 8MB to

16MB for both OSes gives you a performance gain of over 50 percent—well worth paying about \$400 for 8MB of RAM. And Windows 95, being a multitasking, multithreaded OS, also provides snappier task switching. So, if you switch among multiple tasks frequently, 16MB is your sweet spot.

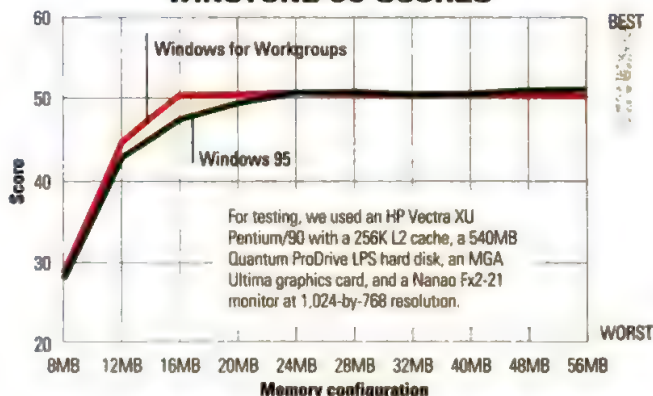
While both OSes show a gain when you upgrade from 12MB to 16MB, going beyond 16MB will give you little

return on your investment. With Windows for Workgroups, performance flattens out at 16MB. Windows 95 gives a slight boost above 16MB of RAM: It doesn't flatten out until it hits 24MB, but the performance gained by upgrading was only about 7 percent.

HOW WE TESTED

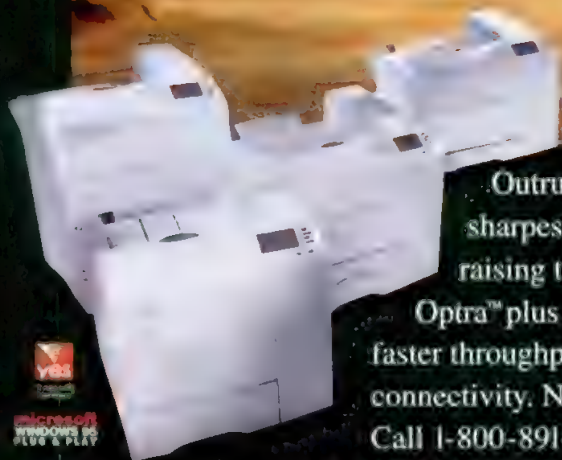
For our test-bed we used an HP Vectra XU with a Pentium/90 CPU, 256KB of L2 cache, and a 540MB hard disk. We used standard, fast-page-mode DRAM. Under Windows for Workgroups, we set virtual memory as follows: a 20MB permanent swapfile and a 32-bit file access equal to one-quarter of the memory, up to 4MB; we also turned on 32-bit disk access. On Windows 95 tests, virtual memory settings were handled by Windows 95 itself.

WINSTONE 96 SCORES



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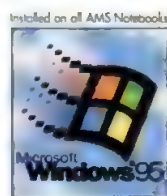
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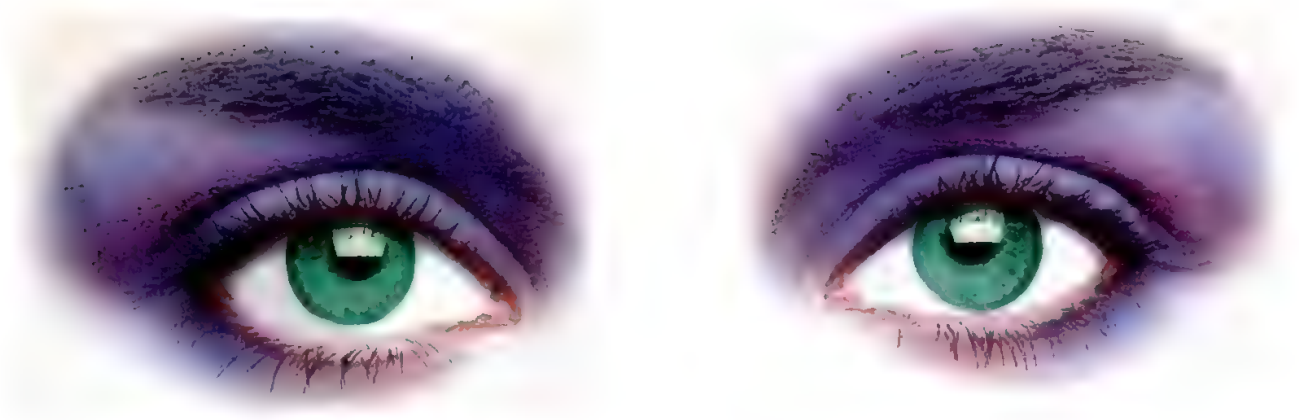
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Building Your Dream Machine



Not all PCs are created equal. To ensure that you buy a computer that will fulfill your needs today as well as satisfy your computing needs of tomorrow, you should choose components very carefully. The guide below will help you outfit your PC to meet your needs.

To compare prices and performance levels of the 83 Windows 95-equipped PCs covered in this story, consult the opposite side of this foldout.

PROCESSOR PRICES have dropped to the point that it no longer makes sense to buy a 486-based PC. If you want an inexpensive entry-level unit, consider a Pentium/75. For more power, step up to a midrange Pentium/90 or Pentium/100. For the most processing power, a high-end Pentium/120 or /133 may be your answer. Be aware that a Pentium/75 with 16MB of RAM can outperform a PC with a faster CPU but less memory, so weigh all options before you buy.

PROCESSOR CACHE The processor cache (often referred to as *external cache*, *secondary cache*, or *L2 cache*) can significantly boost performance. We recommend 256K of synchronous or pipelined-burst L2 cache: Asynchronous cache may be less expensive, but overall system performance will suffer. Some vendors are selling "cacheless" Pentium PCs: We don't recommend this configuration, as our testing has shown that system performance under Windows can degrade by as much as 25 percent.

MEMORY Our testing shows that significant performance gains are to be had in upgrading from 8MB to 16MB of RAM when running Windows 95. We recommend at least 16MB; if you're running high-end graphics or CAD programs, you may want to consider more. It probably will be less expensive to outfit your PC with memory at the time of purchase instead of upgrading later.

HARD DISK It's no secret that Windows 95 takes up a substantial amount of space on your hard disk—up to 60MB for a new installation. And 32-bit applications to support this new OS will use even more disk space than their 16-bit predecessors. We recommend a minimum of 1GB of storage space for any new PC. Fast/Wide SCSI-2 hard disks can offer slightly better performance than Enhanced IDE—if their drivers are optimized—but EIDE disks typically are cheaper. Also be aware of your hard disk's rotational speed if your work is disk-intensive: The average EIDE hard disk spins at 4,600 rpm, and many vendors now

also offer 5,400-rpm devices. On the SCSI front, you can reach up to 7,200 rpm.

GRAPHICS SUBSYSTEM We recommend an accelerated 64-bit PCI graphics adapter with at least 2MB of memory for top graphics performance. For a monitor, don't buy less than a 15-inch model. To take full advantage of Windows 95's multitasking capabilities, consider a 17-inch monitor capable of 1,024-by-768 resolution at 75 Hz.

MULTIMEDIA Quadruple-speed CD-ROM drives have dropped in price to the point that a double-speed model no longer makes sense. Ask for a 16-bit sound card that supports both FM and wavetable synthesis. For speakers, don't settle for the throw-away variety that come bundled with many PCs: You can upgrade to higher-quality speakers for a nominal amount.

SERVICE & SUPPORT Vendor warranties range from one to three years for parts and labor. Some will offer at least a year of on-site service free. Also consider the availability of 24-hour, 7-day toll-free telephone tech support and on-line bulletin boards.



WHERE TO BUY Now that you know what to get, you need to know where to go. A direct vendor will offer a wide selection of custom configurations, but you're also buying sight-unseen. Computer retailers will let you try before you buy, but they tend to charge higher prices. Superstores may have a wide selection of PCs from many vendors, but the salespeople may be generalists. A value-added reseller (VAR) can offer a total solution, whether you want a custom machine or a customized network.

WHAT TO PAY Based on our test configurations (which include 16MB of RAM and a minimum 1GB hard disk) you can expect to pay from about \$2,300 to almost \$4,000 for a midrange Pentium/90 or Pentium/100, and from just under \$3,000 to \$5,000-plus for a high-end Pentium/120 or Pentium/133.

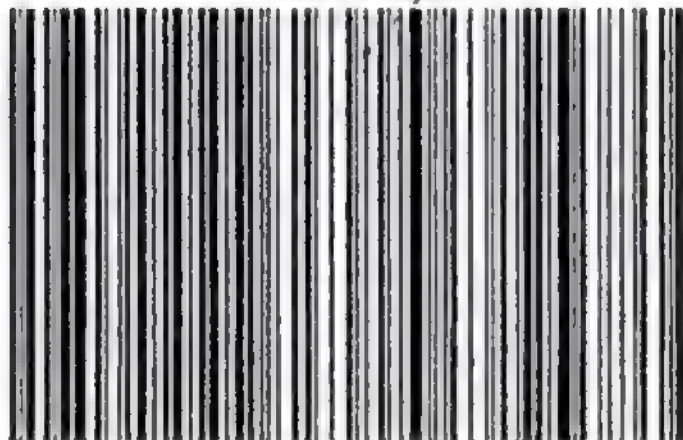
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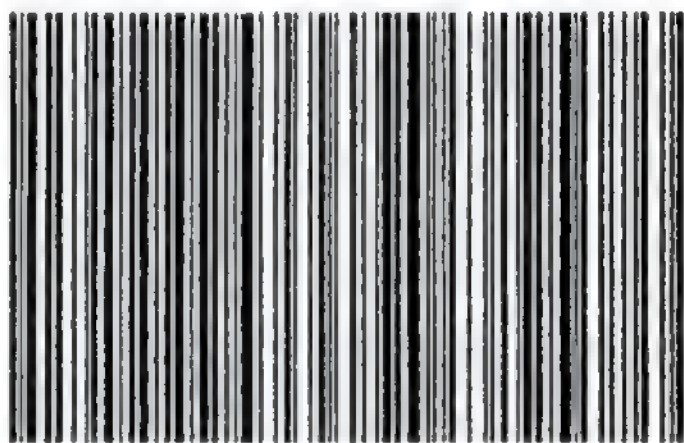
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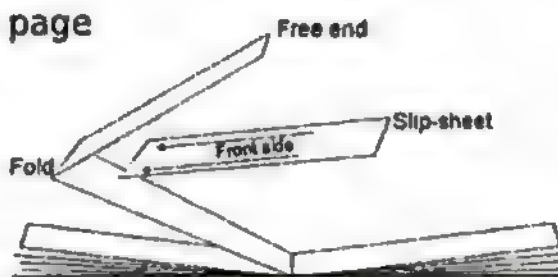
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4. Close the page and slip-sheet



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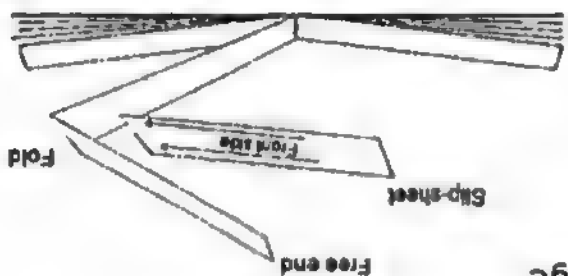
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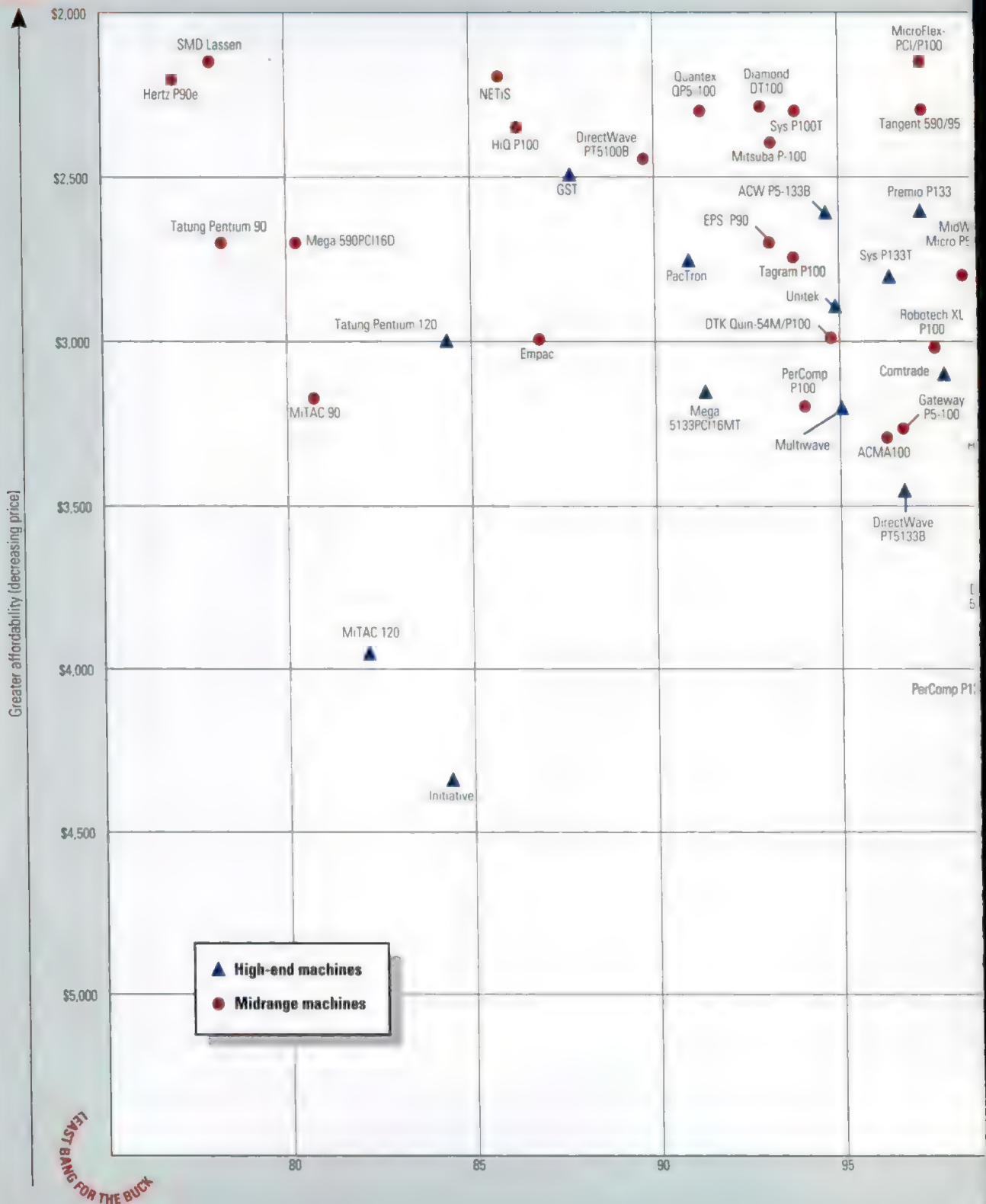
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Windows 95 Pentium PCs

For this roundup, we divided machines into two tiers—midrange and high-end—represented by 90- and 100-MHz Pentiums and 120- and 133-MHz Pentiums, respectively. We chose not to include 486-level PCs in this review, as we did last year, for one reason: We don't think they make sense anymore from a price/performance standpoint.

Keep in mind as you read this chart that these machines are literally the first systems off the assembly lines with Windows 95 installed. By the time you read this, vendors—especially in the graphics accelerator arena—will have had a chance to optimize their drivers for use with Windows 95, and performance probably will only get better.

The two Dell Dimensions, our Editors' Choices, lead the pack on the price/performance scale. The \$2,448 Dimension P100t is an excellent performer. This Pentium/100-based PC's Winstone 96 score was among the best in its CPU class; in fact, its performance rivaled that of some of the 133-MHz systems we tested. The \$3,698 Dimension XPS P133c garners the highest score for features, components, and performance in this roundup, backed by components including a sextuple-speed CD-ROM drive and a 17-inch monitor.

The \$3,278 Digital Celebris GL 5100st, an honorable mention, features a highly integrated internal layout and delivers better-than-average performance within its CPU tier. Video, 16-bit sound, and 10-Mbps Ethernet support are integrated on the motherboard, leaving all five expansion slots on the unit's riser card free for future use. You'll also find built-in SCSI support.

Another machine with an impressive showing, the \$3,495 Ergo ThunderBrick 133, packages

perks like a tape backup drive, a 17-inch monitor, and extra software, as well as a virtually unparalleled four-year parts-and-labor warranty that includes four years of free on-site service and free 24-hour technical support.

The NEC PowerMate P133 also is no slouch in the price/performance index. A 1.5GB hard disk, sextuple-speed CD-ROM drive,

IrDA-compliant infrared port, and MPEG support are just a few of the prizes the PowerMate offers.

This unit is also incredibly easy to set up and service, with features including an

easy-open thumbscrew case, color-coded cables and ports, and a quick-setup poster. An above-average Winstone 96 score proves that it all works well together.

At the opposite end of the performance/features axis, clustered near some of the 90-MHz entries, we surprisingly found some 120-MHz Pentium PCs and even a Pentium/133 unit. Initiative Technology's \$4,335 ITI 5133 unfortunately is one of these systems. Although it includes some compelling extras like a 17-inch monitor and a 28.8-/14.4-Kbps data/fax modem, it was not not a strong performer on our tests, posting a below-average score on our all-important Winstone measure of system performance. It is also backed by a somewhat limited one-year warranty.

Another underachiever on our price/performance measure was the MiTAC Performance Series 120.

This machine's performance was average for the most part, but it fell short on features and warranty, and its price of \$3,950 is relatively high.

One of our midrange entries—the Flex PT100 Business Workstation, from USA Flex—shows that you don't have to sacrifice performance and features in order to keep costs low. This 100-MHz Pentium PC performed well in its class, thanks to an impressive list of well-tuned components that included Intel's Triton chip set, EDO DRAM, and 256K of pipelined-burst L2 cache. Add a 1.2GB EIDE hard disk and a Toshiba quad-speed CD-ROM drive and you have quite an attractive package at \$2,799.

Another low-priced entry in this roundup was the SMD Mount Lassen, from Summit Micro Design. This unit may be priced at only \$2,150, but it is lacking in both performance and features. The system's performance was hobbled mainly by its budget-oriented hard disk, the Conner CFS 1275A. This hard disk will get the job done, but its relatively slow rotational speed of only 3,600 rpm and its slow 22-ms access time just couldn't keep up with those of the fastest systems, whose EIDE hard disks spin at 5,400 rpm. And poor disk performance affects virtually every test we run, including our Winstone tests.

—Analysis written by Mary E. Behr



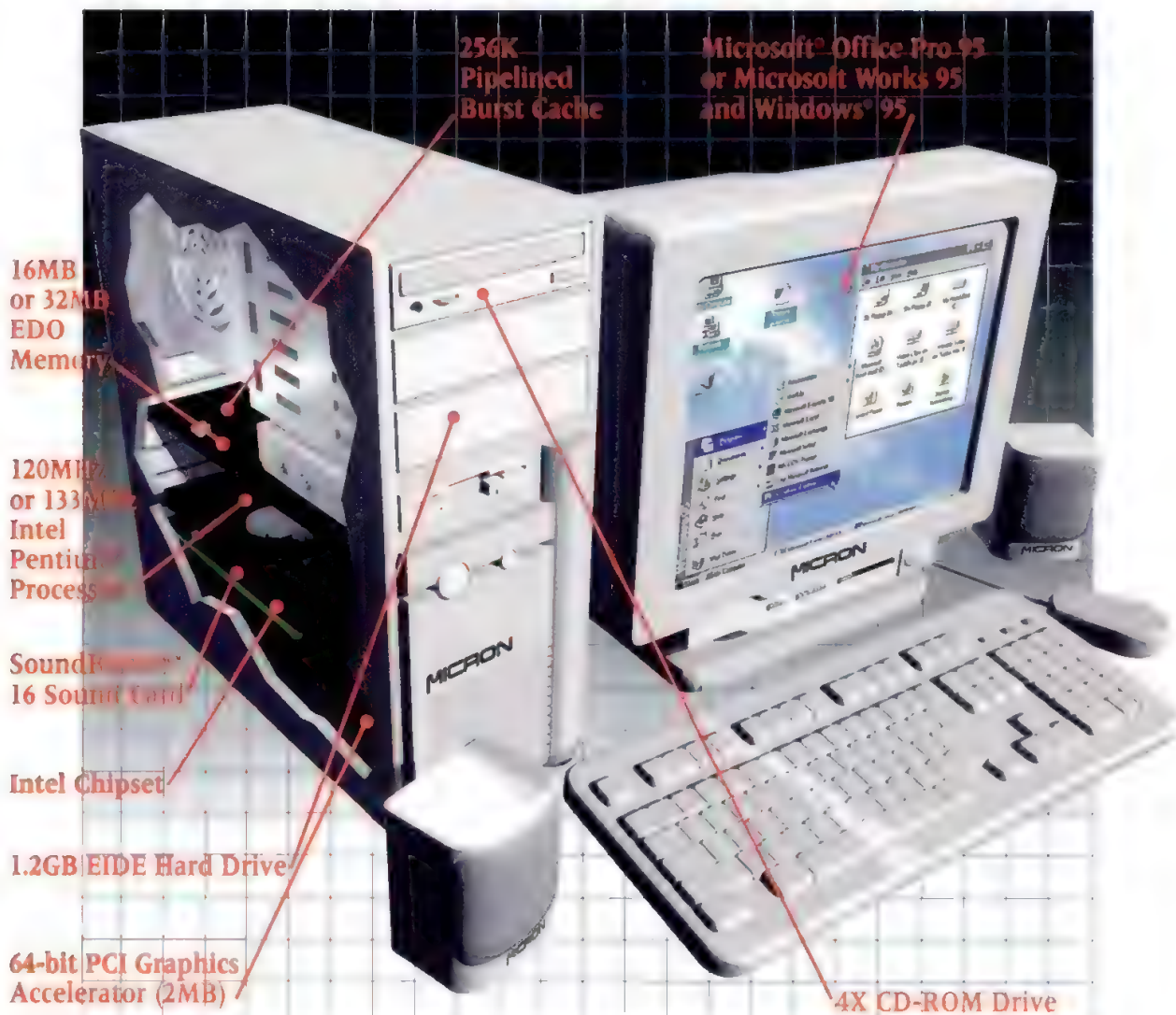
The Data Points

Scores on our benchmark tests, particularly Winstone 96, account for almost half of the price/performance ratio. The warranty term, technical support, and ratings from our Service and Reliability survey account for almost 10 percent. Features, components, and expandability make up the remainder of the score.

Price/performance index data can be found in the Hardware Library of the Editorial Forum on PC MagNet under 21BANG95.TXT and on the World-Wide Web at <http://www.ziff.com/~pcmag/pclabs/pclabs.htm>.

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June 28, 1994
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P75 HOME MPC

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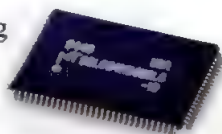
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• 15" Micron 15FGx, 1280NI, .28mm monitor
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May 30, 1995
P120 MILLENNIA

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- PCI 64-bit graphics accelerator (2MB)
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be installed in one of the two slots that can accommodate it.

The MPEG in the name of the system refers to the software MPEG capability of the Diamond Stealth64 Video VRAM card installed.

The Dream Machine was an average performer on the Graphics WinMark 96 test. A 1GB Quantum Fireball hard disk helped the unit post a Disk WinMark 96 score that was slightly above average. The Dream Machine also posted an above-average Winstone 96 score.

The Dream Machine is covered for only one year on parts and labor. On-site service is an additional \$25 for the first year.—WPF

Comtrade, City of Industry, CA 91745; 800-969-2123, 818-961-6688, fax, 818-369-1479.

Circle 479 on reader service card

Data Storage Marketing Inc.

DataStor P5-100, DataStor P5-133

Data Storage Marketing offers two solid performers in the \$3,795 DataStor P5-133 and the \$3,495 DataStor P5-100 PCs. Both should please their intended audience: corporations and small-office/home-office users.

Both Data Storage machines are

IN SHORT

These units' solid performance should please small- and large-business users.



housed in desktop cases, which amazingly include seven drive bays without limiting access to any components: a rarity in this form factor. These systems are also configured well and are identical in every way except for the processor. Both included 1GB hard disks, Number Nine Imagine 128 graphics accelerator cards with 4MB of VRAM, and 15-inch ViewSonic monitors. These PCs also come with Creative Labs Sound Blaster AWE32 cards, which support wavetable and FM synthesis, and a set of Yamaha YST-M10 speakers.

The P5-133 posted average scores across our Windows-based tests for its 133-MHz Pentium class. The P5-100 fared well also. Its combination of components helped produce above-average Winstone 96 and Graphics WinMark 96 scores, while its Disk WinMark 96 score was average for its group.

Data Storage completes this package with a three-year warranty. On-site service is an additional \$50 per year.—WPF
Data Storage Marketing Inc., Boulder, CO; 800-543-6090, 303-442-4747; fax, 303-442-7985.

Circle 480 on reader service card

Dell Computer Corp.

Dimension P100t, Dimension XPS P133c, OptiPlex GM+ 5100



Great systems offered at competitive prices are what put Dell Computer Corp. on the map, and it's why two of Dell's entries in this roundup—the \$2,378 Dimension P100t and the \$3,698 Dimension XPS P133c—are Editors' Choice recipients. We also looked at Dell's new network-ready corporate PC, the OptiPlex GM+ 5100. Dell targets the Dimension line toward small-office/home-office buyers, and the Dimension XPS at power users.

The Dimension minitower machines are similarly equipped. The principal differences between them are the processor speed and the video cards: The Dimension XPS P133c features a Number Nine Imagine 128 graphics accelerator card with 4MB of VRAM while the Dimension P100t relies on an integrated S3

Trio64 chip set with 2MB of DRAM.

The Dimension P100t's Winstone 96 score was among the best in its processor group. In fact, it rivaled the scores of some 133-MHz systems. This system's 1GB Quantum Fireball hard disk helped the Dimension to post a Disk WinMark 96 score that was also among the leaders in its group. Its Graphics WinMark 96 score was average.

The Dimension XPS P133c included some top-notch components, such as a 17-inch monitor, a 1.5GB EIDE hard disk, and a TEAC sextuple-speed CD-ROM drive. It posted average scores on all Windows-based tests.

The \$3,092 OptiPlex GM+ 5100 desktop is ready to plug into your network through its integrated 3Com EtherLink 10-Mbps Ethernet connector. The system is also DMI compliant, so it's easy for your IS department to track and update the machine's status once you've hooked this PC to your LAN.

The OptiPlex's motherboard had EDO DRAM and 256K asynchronous external cache as well as a S3 Trio64 graphics chip with 2MB of DRAM. Sound is handled by a Creative Labs sound card with FM synthesis capability.

On our benchmark tests, the OptiPlex posted an average Winstone test score compared with that of its 100-MHz Pentium competition. Its Disk WinMark and Graphics WinMark test scores were below average.

Dell backs each of these systems with a three-year warranty on parts, one year on labor; one year of on-site service is included. There is also 24-hour, 7-day phone support.—WPF

Dell Computer Corp., Austin, TX; 800-433-8110, 512-338-4400; fax, 800-727-8320.

Circle 468 on reader service card



IN SHORT

All three are good choices, but the Dimensions offer more for the buck.

SERVICE & RELIABILITY Dell Computer Corp.

Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Average

DFI

DFI Landmarq P133VPM

Business users will appreciate DFI's \$3,999 Landmarq P133VPM. For the money, the Landmarq includes connectivity amenities like a 28.8/14.4-Kbps data/fax modem and a DFI Net-800P PCI Ethernet adapter; it also comes with a 17-inch ADI MicroScan SEP monitor. Its performance on our benchmark tests was poor, however.

The Landmarq offers plenty of expansion room. In addition to ten free drive bays in the tower case, the Landmarq's DFI motherboard can be pumped up to accommodate 256MB of RAM. A second ZIF socket can

support another 133-MHz Pentium processor; the system is MP 1.1 compliant.

The Landmarq came with a quad-speed CD-ROM drive, a Creative Labs Sound Blaster Pro board (which offers FM synthesis only), and MLI speakers. The unit's integrated video subsystem is based on the S3 Trio64 chip set with 2MB



IN SHORT

Great extras, including a network card, fax modem, and a 17-inch monitor.

of DRAM.

The Landmarq's performance was not top-flight: It posted below-average scores on our Winstone 96, Disk WinMark 96, and Graphics WinMark 96 tests. The unit lacked EDO DRAM; that, combined with its VLSI chip set and its use of buffered write-through asynchronous cache instead of the more efficient write-back synchronous cache, slowed the processor and memory subsystems, contributing to the unit's lackluster performance. The use of a graphics engine with slower DRAM also hindered performance.

DFI offers a two-year parts and lifetime-labor warranty with this system. On-site service is \$58 for the first year.—John R. Quain

DFI, Sacramento, CA; 800-808-4334, 916-568-1234; fax, 916-568-1233.

Circle 481 on reader service card

Diamond Technologies Inc.

Diamond Office Star DT100, Diamond Office Master DT133

Direct marketer Diamond Technologies' two offerings for Windows 95 users are comparatively inexpensive. But the \$2,735 Diamond Office Master DT133 and the \$2,285 Diamond Office Star DT100 don't deliver high-end features or top-notch performance.

The 133-MHz Pentium-based Office Master comes in a midsize tower case that holds two drive bays more than the Pentium/100-based Office Star's minitower. Inside the case is an ASUSTek motherboard that features a proprietary MediaBus connector designed for an ASUSTek combination graphics and audio card, but the slot was not used.

Instead, for video and sound, both PCs use Diamond Stealth Video graphics adapters (with 2MB of DRAM on the DT133 and 1MB on the DT100) and 16-bit Media Sound 16 sound boards with a ShockWave MIDI wavetable synthesizer. The Office Star comes with a 14.4-Kbps fax modem; the Office Master comes with a 28.8-/14.4-Kbps data fax modem. Both models also include a quad-speed Mitsumi CD-ROM drive, a 15-inch Impression monitor, and a 1GB IDE hard disk.

On our benchmark tests, both machines posted above-average Disk WinMark 96 scores and below-average Graphics WinMark 96 scores. On our Winstone 96 test, the Office Star's score was above average, while the Office Master garnered an average result.

Diamond Technologies includes a one-year, warranty on parts and labor and free on-site service with both machines.

—JRQ

Diamond Technologies Inc., Anaheim, CA; 800-989-7253, 714-533-9910; fax, 714-533-7805.

Circle 482 on reader service card



IN SHORT

Good prices combined with respectable performance and fax modems.

Digital Equipment Corp.

Digital Celebris GL 5100st, Digital Celebris XL 5133

The Celebris line of PCs from Digital Equipment Corp. is aimed at the high-end business market.

We tested two Celebris units that may share the same name, but they're very different. The \$3,278 Celebris GL 5100st short tower has a highly integrated internal design and offers better-than-average performance within its processor class. The \$5,049 Celebris XL 5133 tower was also a strong performer; the system comes with a SCSI-2 hard disk and is multiprocessor capable.

The designers of the Celebris GL 5100st have left the user plenty of expansion room for future use: Video, 16-bit sound, and an Ethernet adapter are all integrated on the motherboard. That leaves all five expansion slots (one PCI, one shared PCI/ISA, and three ISA) on the unit's riser card available. The riser card also integrates two SCSI connectors for additional internal and external devices. (A Token-Ring card is available for \$475.)

The GL 5100st is also a very good performer. It did especially well on our Winstone 96 and Graphics WinMark 96 tests, earning above-average scores on both tests. The unit's Disk WinMark 96 score was average for the 100-MHz Pentium processor class.

The XL 5133 provides an integrated SCSI connector on its Neptune-based motherboard. The unit's 133-MHz Pentium processor is on a card, which facilitates upgrades. The card has a proprietary cache socket and a second ZIF socket for multiprocessing as well. If you want, you



IN SHORT
Both Digital Celebris systems are solid, well-built performers.

SERVICE & RELIABILITY Digital Equipment Corp.

Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Better than average



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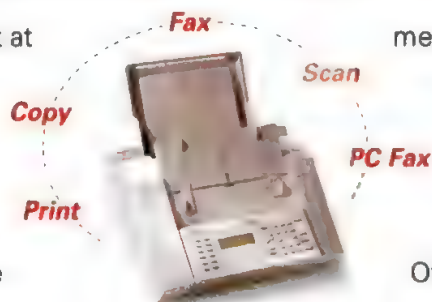
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Why the only thing I had to eat today was a week-old, slightly linty sourball.

scratches I could hardly read let alone agree with. So there I sat, page by page, plan by plan,

muttering things under my breath while time passed

and the sun went down and the cleaning guy packed



up his floor polisher and went home, while I sat at my desk looking frantically for

those sourballs I had in my sportcoat pocket. Because a guy's gotta eat, you know?

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Benchmark Tests: Midrange Windows 95 Pentium PCs

What the Numbers Mean

We defined *midrange systems* for this roundup as those with both 90-MHz and 100-MHz Pentium processors. Though they are not the fastest available, they still offer good performance at a lower price than you can get with top-of-the-line Pentium/133s. In fact, the top-scoring Pentium/100 PC posted a Winstone 96 score that matched the Winstone average of the Pentium/133 entries. But while these Windows 95-equipped machines did not outperform their Windows 3.x siblings on some tests, Windows 95's 32-bit structure is already giving a boost to graphics, video, and CD-ROM performance.

WINSTONE 96

It takes a combination of top-flight subsystems to give a PC the top Winstone 96 score. The highest Winstone scores went to those machines using synchronous L2 cache, hard disks with fast rotational speeds, and 64-bit graphics accelerators.

The top Pentium/90 PC on the Winstone tests was the Tangent MediaStar 590/95. This system combined synchronous L2 cache and EDO DRAM with a Quantum Fireball 1080A hard disk and the new STB Powergraph 64 Video graphics card (powered by S3's Trio64V+ chip set) to produce its high-flying score.

The two top-scoring P100 systems were Sys Technology's Performance P100T and Polywell Computers' Poly 5100T3. The Performance P100T combined 512K of 8.5-nanosecond pipelined-burst L2 cache, a Quantum Fireball 1080A hard disk, and a Diamond Stealth64 Video DRAM graphics card. The Poly 5100T3 came with the same hard disk and a Diamond Stealth64 Video VRAM graphics card but opted for 256K of synchronous L2 cache.

Lack of processing power proved to be the downfall for one system. The Gateway P5-100 does not come with L2 cache, and its CPUmark₁₆ score shows it. And low processor performance can affect all benchmark test scores. It can explain why an otherwise well-outfitted machine does not perform up to its potential. The Gateway P5-100's Winstone score illustrates this point; although this PC used a Western Digital Caviar 21000H hard disk and a Matrox Millennium graphics card, its Winstone score was nearly 25 percent lower than those of all other Pentium/100 systems tested. It simply was not able to overcome the anemic performance of its CPU subsystem.

Each of the top-scoring systems was based on Intel's Triton chip set. In general, we saw a continuing pattern of systems based on other vendors' chip sets not performing as well as Triton-equipped machines. Other subsystems notwithstanding, PCs without Triton chip sets were almost 10 percent behind those with Triton chip sets.

GRAPHICS WINMARK 96

Somewhat surprisingly, the top-scoring Pentium/90 system on our Graphics WinMark 96 test—the Tangent MediaStar 590/95—came with an STB Powergraph 64 Video card that had the S3 Trio64V+ chip set and 2MB of EDO DRAM. While the Trio64V+ adds support for hardware-assisted

video playback, software MPEG-1, colorspace conversion, and the use of either DRAM or EDO DRAM, its support for graphics is basically unchanged.

The reason for its stellar performance may be its Windows 95 driver. All other systems were tested using the Microsoft Windows 95-supplied minidriver. We used this driver because graphics board vendors have not yet written their own drivers for Windows 95. The vendors are waiting for Windows 95's Direct X support so that they can build one full driver that supports all of Windows 95's features.

The Trio64V+ is a new chip and is not yet supported by Windows 95. In this roundup, we allowed Tangent to use a driver written by STB specifically for the Trio64V+. It is possible that STB was able to tune this specific driver enough to give it a performance edge on our tests.

The Matrox Millennium graphics card was found in other top-performing Pentium/100 systems. The Digital Celebris GL 5100st and Tagram Thunderbolt P100 each used Matrox's newest graphics accelerator. The Millennium is unique in its use of Window RAM (or WRAM, developed by Samsung). WRAM, like VRAM, is dual-ported, and it has several enhancements designed specifically for GUI environments, including a color write-block mode and a memory design for fast font rendering.

DISK WINMARK 96

All of the midrange systems used IDE hard disks, and once again the Quantum Fireball proved to be the speediest Fast ATA-2 drive. Fast ATA-2 is Seagate's specification for IDE hard disks, similar to Western Digital's Enhanced IDE (EIDE) specification. The Quantum Fireball has a rotational speed of 5,400 rpm and an extremely low average latency of 5.56 milliseconds. This gives the Fireball the highest transfer rate we have seen from either a Fast ATA-2 or EIDE disk. The top Pentium/90 and the top nine Pentium/100 systems each had a Quantum Fireball.

Each of our top finishers also had a motherboard based on Intel's Triton chip set, which supports bus-mastering PCI EIDE. It has an integrated EIDE controller capable of both mode 3 (11.1-MBps) and mode 4 (16.7-MBps) data transfers. Triton also supports data streaming over the PCI bus at 100 MBps and faster, for transferring full-motion video, graphics, audio, and large files over the network.

CPUMARK₁₆ AND CPUMARK₃₂

WinBench 96 offers two new tests for measuring processor subsystem performance: CPUmark₁₆ and CPUmark₃₂. The difference between these tests is the type of applications we profiled to construct them. CPUmark₁₆ is a 16-bit test that reflects a processor's usage of 16-bit applications, while CPUmark₃₂ is a 32-bit test that mirrors the processor's behavior with 32-bit applications.

Using Triton-based motherboards and synchronous or pipelined-burst L2 cache proved to be the winning ticket on our CPU subsystems tests. The Tangent MediaStar 590/95

WINSTONE 96

Score ► 0 10 20 30 40 50 60 70

Pentium/90 systems

EPS Pinnacle P90	47
Hertz P90e	42
Mega Impact 590PC116D	49
MITAC Performance Series 90	47
SMD Mount Lassen	41
Tangent MediaStar 590/95	51
Tatung UNIQ 5510 Pentium 90	41

Pentium/100 systems

ACMA z-Power 100	55
AMAX P100 Powerstation	53
AT&T Globalyst 630	53
Compaq Deskpro 5100	48
Data Storage DataStor P5-100	57
Dell Dimension P100t	60
Dell OptiPlex GMT+ 5100	51
Diamond Office Star DT 100	55
Digital Celebris GL 5100	56
DirectWave Blue Thunder	56
DTK QUIN-54M/P100	47
Empac Saber P54-100	43
Ergo ThunderBrick 100	53
Gateway 2000 P5-100	39
HiQ Saturn P100	48
Maximus Magna ProMedia	58
Micro Express MicroFLEX-PCI/P100	55
Micron P100 Millennium	58
MidWest Micro P5-100 Office PC	45
Mitsuba Executive P-100	47
NEC PowerMate V100	48
NETIS Budget N5100P	46
PerComp P100 Professional	50
Polywell Poly 5100T3	61
Quantex QP5/100 M-4	49
Robotech Cobra XL P100	42
Robotech Cobra XLT P100	50
Sys Performance P100T	61
Tagram Thunderbolt P100	49
USA Flex Business Workstation	56

WORST

BEST

placed first among Pentium/90 systems with the help of 256K of fast 8-ns L2 cache and EDO DRAM. Sys's Performance P100T utilized 512K of 8.5-ns pipelined-burst L2 cache to make it the top-scoring Pentium/100. With most vendors installing 256K of L2 cache, the extra 256K from Sys was enough to propel its PC to first place.

The AT&T Globalyst 630 came in with a very low CPU score. PC Labs reviewed all user-available settings and was unable to find an obvious problem. The Globalyst 630 was one of only three systems to use the VLSI VL82C591 chip set. We suspect that this machine's memory subsystem was set with excess wait states, or that there was a timing problem that caused the system's poor scores.

CD-ROM WINMARK 96

As an overall measure of a PC's CD-ROM subsystem, the CD-ROM WinMark 96 tests can identify the best-performing CD-ROM drives. As expected, the fastest CD-ROM drives—the sextuple-speed models—produced the best scores. The 6X TEAC CD-56E in the Micron P100 Millennium and the 6X NEC CDR-512 in the AMAX P100 Power-

GRAPHICS WINMARK 96

Score ► 0 2 4 6 8 10 12 14 16 18 20

Pentium/90 systems

EPS Pinnacle P90	14.5
Hertz P90e	9.9
Mega Impact 590PC116D	15.7
MITAC Performance Series 90	12.9
SMD Mount Lassen	10.4
Tangent MediaStar 590/95	17.0
Tatung UNIQ 5510 Pentium 90	10.5

Pentium/100 systems

ACMA z-Power 100	18.0
AMAX P100 Powerstation	18.1
AT&T Globalyst 630	15.2
Compaq Deskpro 5100	15.3
Data Storage DataStor P5-100	17.6
Dell Dimension P100t	16.0
Dell OptiPlex GMT+ 5100	13.7
Diamond Office Star DT 100	13.7
Digital Celebris GL 5100	18.3
DirectWave Blue Thunder	17.8
DTK QUIN-54M/P100	16.1
Empac Saber P54-100	15.3
Ergo ThunderBrick 100	16.6
Gateway 2000 P5-100	15.3
HiQ Saturn P100	13.4
Maximus Magna ProMedia	16.6
Micro Express MicroFLEX-PCI/P100	16.8
Micron P100 Millennium	16.8
MidWest Micro P5-100 Office PC	12.4
Mitsuba Executive P-100	15.3
NEC PowerMate V100	12.3
NETIS Budget N5100P	12.9
PerComp P100 Professional	17.6
Polywell Poly 5100T3	17.9
Quantex QP5/100 M-4	14.2
Robotech Cobra XL P100	11.4
Robotech Cobra XLT P100	17.7
Sys Performance P100T	17.4
Tagram Thunderbolt P100	19.9
USA Flex Business Workstation	18.1

WORST

BEST

station were at the head of the CD-ROM class on our tests. The quad-speed Sony CDU76E showed some consistency by placing at the top of the charts among Pentium/90 machines and near the top among the Pentium/100s.

CD-ROM SEQUENTIAL 16K READ

Here we look for scores that come close to the rated CD-ROM speeds as published by the vendors. All test results were close to the rated speeds of the respective CD-ROM drives.

CD-ROM ACCESS TIME

Drive manufacturers each tune their drives differently. While some may tune for the lowest average access times, others optimize for highest throughput rates. Therefore, the 6X drives may not always produce the lowest or best scores (for our Access Time tests, lower scores represent better performance).

Identical CD-ROM drives found in PCs with like CPUs should ideally produce access times that are close to one another. One case where this was not so was with the Mitsumi CRMC-FX400 quad-speed drive found in the Tatung UNIQ 5510 Pentium 90. Its access time was almost twice as high as

DISK WINMARK 96

Score ▶ 0 200 400 600 800 1,000 1,200

Pentium/90 systems

EPS Pinnacle P90	778
Hertz P90e	789
Mega Impact 590PCI16D	921
MITAC Performance Series 90	777
SMD Mount Lassen	595
Tangent MediaStar 590/95	1,000
Tatung UNIQ 5510 Pentium 90	576

Pentium/100 systems

ACMA z-Power 100	1,060
AMAX P100 Powerstation	852
AT&T Globalyst 630	921
Compaq Deskpro 5100	757
Data Storage DataStor P5-100	877
Dell Dimension P100t	1,030
Dell OptiPlex GMT+ 5100	797
Diamond Office Star DT 100	1,070
Digital Celebris GL 5100	918
DirectWave Blue Thunder	1,070
DTK QUIN-54M/P100	820
Empac Saber P54-100	598
Ergo ThunderBrick 100	636
Gateway 2000 P5-100	829
HiQ Saturn P100	672
Maximus Magna ProMedia	943
Micro Express MicroFLEX-PCI/P100	1,010
Micron P100 Millennia	944
MidWest Micro P5-100 Office PC	875
Mitsuba Executive P-100	605
NEC PowerMate V100	980
NETIS Budget N5100P	821
PerComp P100 Professional	858
Polywell Poly 5100T3	1,040
Quantex QP5/100 M-4	776
Robotech Cobra XL P100	692
Robotech Cobra XLT P100	877
Sys Performance P100T	1,060
Tagram Thunderbolt P100	1,070
USA Flex Business Workstation	846

WORST

BEST

the scores of systems using other, identical CD-ROM drives. We found that the Tatung PC's standard IDE controller card was showing a conflict in Windows 95's Device Manager, which could explain its ATAPI (IDE) CD-ROM drive's poor performance.

CD-ROM CPU UTILIZATION

CD-ROM CPU Utilization scores reflect processor resources expended while retrieving data from the CD-ROM. A lower number here denotes a better result, as it means the CPU has more time to service other requests. A consistently low-scoring CD-ROM drive was the Mitsumi

can also swap the Intel-based processor card for one with Digital's Alpha CPU (\$2,399).

Using a PCI-based Matrox Millennium graphics card with 2MB of WRAM, the XL 5133 achieved an above-average Graphics WinMark score. Its Winstone and Disk WinMark scores were average for its processor class.

To round out these packages, Digital includes a three-year warranty on parts and labor for each of the Celebris machines. One year of on-site service is also covered.—WPF

Digital Equipment Corp., Maynard, MA;
800-642-4532, 508-624-6400; fax, 800-652-4532.

Circle 469 on reader service card

CPUMARK 16

Score ▶ 0 50 100 150 200 250

Pentium/90 systems

EPS Pinnacle P90	176
Hertz P90e	175
Mega Impact 590PCI16D	193
MITAC Performance Series 90	171
SMD Mount Lassen	192
Tangent MediaStar 590/95	202
Tatung UNIQ 5510 Pentium 90	184

Pentium/100 systems

ACMA z-Power 100	219
AMAX P100 Powerstation	221
AT&T Globalyst 630	149
Compaq Deskpro 5100	206
Data Storage DataStor P5-100	221
Dell Dimension P100t	222
Dell OptiPlex GMT+ 5100	193
Diamond Office Star DT 100	213
Digital Celebris GL 5100	206
DirectWave Blue Thunder	223
DTK QUIN-54M/P100	201
Empac Saber P54-100	193
Ergo ThunderBrick 100	218
Gateway 2000 P5-100	174
HiQ Saturn P100	186
Maximus Magna ProMedia	213
Micro Express MicroFLEX-PCI/P100	208
Micron P100 Millennia	224
MidWest Micro P5-100 Office PC	170
Mitsuba Executive P-100	192
NEC PowerMate V100	187
NETIS Budget N5100P	169
PerComp P100 Professional	216
Polywell Poly 5100T3	223
Quantex QP5/100 M-4	194
Robotech Cobra XL P100	178
Robotech Cobra XLT P100	208
Sys Performance P100T	231
Tagram Thunderbolt P100	219
USA Flex Business Workstation	221

WORST

BEST

CRMC-FX400, with an average utilization of about 40 percent. (Note that CPU utilization scores can be compared only across same-speed CD-ROM drives.)

VIDEO DATA RATE AND SCALING

To test video performance, we used .AVI clips with different data rates, as well as one clip that scales to full screen. We used the 32-bit Indeo and Cinepak codecs included with Windows 95. In general, systems that employ graphics chips with built-in video acceleration (such as S3's Vision968 and Trio 64V+ chip sets) perform the best on these tests.

—Analysis written by Richard Fisco

DirectWave Inc.

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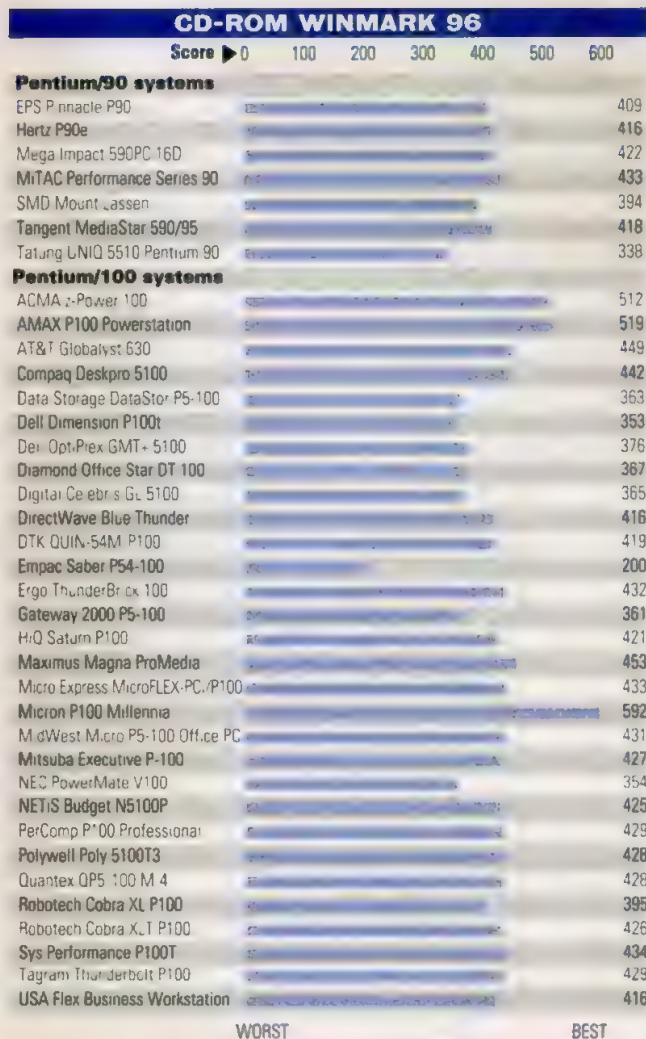
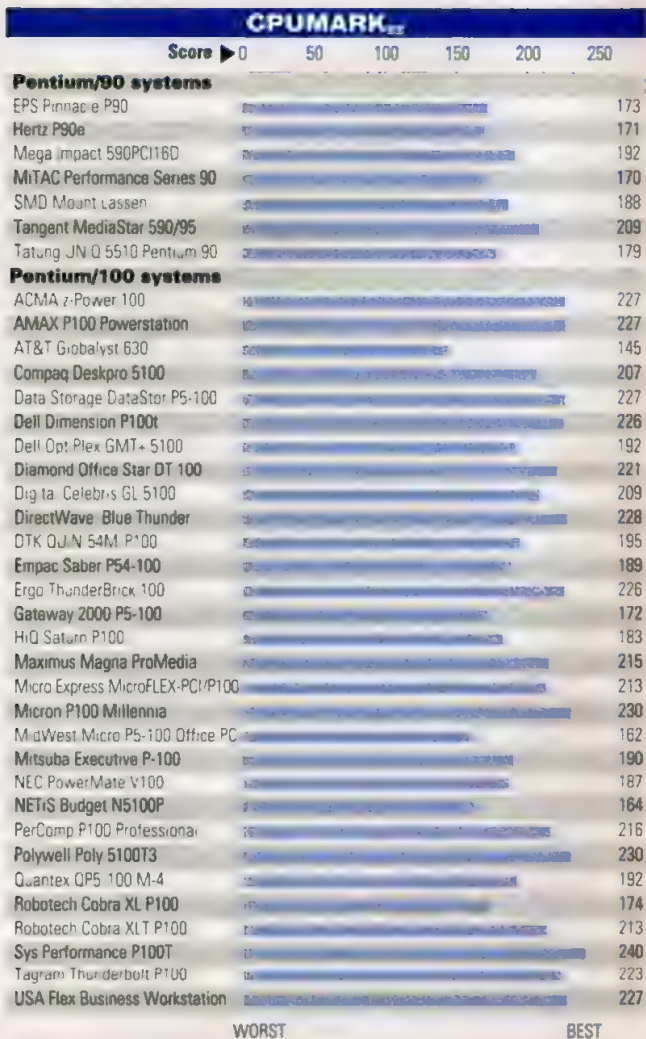


¹Battery life will vary based on power management applications, configurations and other user preferences. ²MB stands for million bytes. Accessible capacity varies. ³M-F 8am-8pm EST. In Canada, call IBM's HelpFax at 1 800 465-3299 (ask for document #452161). IBM and ThinkPad are registered trademarks and "There is a difference" is a trademark of International Business Machines Corporation. Pentium is a registered trademark of Intel Corp. ©1995 IBM Corporation



Benchmark Tests: Midrange Windows 95 Pentium PCs

CONTINUES



quality components. These minitowers—aimed at corporate power users—have ASUSTek motherboards with a proprietary MediaBus connector attached to one of

four PCI slots. The connector can host regular PCI cards or special sound/graphics cards.

Both systems rely on EDO DRAM, Quantum Fireball 1GB hard disks, and Diamond Stealth-64 Video VRAM graphics boards.

In addition to the PT5P133B's faster CPU, you get a Toshiba quad-speed CD-ROM drive, 17-inch MAG monitor,

a Creative Labs Sound Blaster AWE32 card capable of FM and wavetable synthesis, and a pair of Conch speakers.

The 100-MHz PT5P100B lacks high-fidelity multimedia components but is a good choice for all-around use. It comes with a 15-inch MAG monitor and a Creative Labs Vibra 16 sound board.

The PT5P100B had better-than-average scores for its CPU group on our Windows-based tests, and it handled video-playback chores without any glitches. The PT5P133B measured up to the others in its category on Windows-based tests and had no trouble delivering reliable video and audio playback.

These systems come with a one-year parts and lifetime-labor warranty. On-site service for one year is \$45.—*JRQ*
DirectWave Inc., Ontario, CA; 800-882-8108, 909-390-8098; fax, 909-390-8061.

Circle 483 on reader service card

DTK Computer Inc.

QUIN-54M/P100, QUIN-54M/P133

Although both the \$3,700 QUIN-54M/P133 and the \$2,990 QUIN-54M/P100 (street prices) from DTK Computer use many of the same parts as

other PCs in this roundup, their performance was hampered by the absence of pipelined-burst cache; a faulty BIOS also negatively affected test scores. These units are aimed at general Windows 95 users, but DTK also offers QUIN-61 slimline PCs for



IN SHORT

DirectWave combines good prices with well-chosen components.

IN SHORT

These units yielded poor performance, partly because of a faulty BIOS.

SERVICE & RELIABILITY DTK Computer Inc.

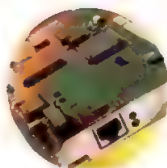
Reliability	Average
Repair	Average
Technical support	Average
Percent needing repair	Average



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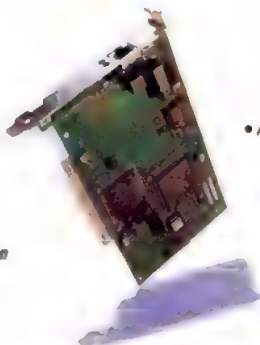
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- ▲ Higher scores represent better performance.
▼ Lower scores represent better performance.

	WINSTONE 96				CD-ROM			VIDEO DATA RATE ¹		FULL-SCREEN VIDEO SCALE ²		VIDEO MATRIX ³	
	Spread-sheet	Word Processing	Database	Business Graphics/DTP	Sequential 16K Read	Access Time (ms)	CPU Utilization	Frames Dropped	CPU Utilization	Frames Dropped	CPU Utilization	Frames Dropped	CPU Utilization
Pentium/90 systems													
EPS Pinnacle P90	4.4	4.9	4.9	4.7	612 KBps	245	42%	0	59%	0	68%	3	53%
Hertz P90e	3.6	4.4	4.5	4.4	612 KBps	194	67%	0	85%	0	87%	0	72%
Mega Impact 590PCI16D	4.5	5.0	5.2	5.0	610 KBps	190	65%	13	89%	9	88%	0	62%
MITAC Performance Series 90	4.3	4.8	4.9	4.7	612 KBps	223	49%	0	94%	100	99%	0	60%
SMD Mount Lassen	3.6	4.4	4.1	4.3	612 KBps	211	63%	0	86%	0	90%	0	68%
Tangent MediaStar 590/95	4.7	5.3	5.2	5.2	620 KBps	240	42%	0	89%	287	99%	0	48%
Tatung UNIQ 5510 Pentium 90	3.6	4.3	4.1	4.3	611 KBps	419	47%	0	63%	0	72%	0	57%
Pentium/100 systems													
ACMA z-Power 100	5.0	5.6	6.0	5.7	917 KBps	212	48%	5	81%	0	89%	0	45%
AMAX P100 Powerstation	4.9	5.5	5.5	5.4	917 KBps	206	47%	0	66%	0	71%	0	45%
AT&T Globalyst 630	5.0	5.6	5.5	5.4	612 KBps	245	52%	6	98%	349	99%	0	55%
Compaq Deskpro 5100	4.3	5.1	5.0	5.0	613 KBps	221	44%	4	91%	197	99%	0	54%
Data Storage DataStor P5-100	5.3	6.0	6.0	5.7	612 KBps	364	34%	40	99%	355	99%	0	44%
Dell Dimension P100t	5.4	6.1	6.4	6.1	612 KBps	312	44%	0	77%	0	75%	0	48%
Dell OptiPlex GMT+ 5100	4.7	5.2	5.2	5.2	613 KBps	264	39%	13	82%	8	81%	0	49%
Diamond Office Star DT 100	4.8	5.7	6.1	5.8	613 KBps	291	38%	0	84%	6	99%	0	45%
Digital Celebris GL 5100	5.2	5.8	5.8	5.5	613 KBps	293	43%	0	89%	0	92%	0	49%
DirectWave Blue Thunder	5.0	5.7	6.1	5.7	614 KBps	238	37%	0	72%	0	84%	0	43%
DTK QUIN-54M/P100	4.3	4.9	4.8	4.8	612 KBps	193	65%	0	63%	0	67%	0	64%
Empac Saber P54-100	4.1	4.5	4.4	4.5	615 KBps	244	79%	0	61%	0	77%	0	56%
Ergo ThunderBrick 100	5.0	5.6	5.3	5.3	610 KBps	191	62%	0	78%	0	89%	0	56%
Gateway 2000 P5-100	3.5	4.1	4.1	4.2	613 KBps	281	39%	441	100%	425	99%	0	52%
HiQ Saturn P100	4.4	5.0	4.6	5.0	613 KBps	194	62%	405	99%	424	99%	0	64%
Maximus Magna ProMedia	5.4	6.0	6.0	5.8	911 KBps	257	62%	0	67%	0	81%	0	44%
Micro Express MicroFLEX-PC/P100	5.1	5.7	5.8	5.7	613 KBps	230	45%	0	73%	199	99%	0	52%
Micron P100 Millennia	5.5	6.1	6.0	5.7	919 KBps	177	47%	0	55%	0	71%	0	41%
MidWest Micro P5-100 Office PC	4.0	4.7	4.7	4.7	680 KBps	222	59%	0	86%	0	91%	0	59%
Mitsuba Executive P-100	4.3	5.0	4.6	4.7	611 KBps	185	61%	0	68%	0	80%	0	63%
NEC PowerMate V100	4.2	5.0	5.1	4.9	613 KBps	320	45%	0	78%	0	82%	0	59%
NETIS Budget N5100P	4.3	4.8	4.8	4.6	677 KBps	237	63%	0	75%	0	86%	0	62%
PerComp P100 Professional	4.6	5.2	5.2	5.2	610 KBps	203	62%	0	60%	0	78%	0	57%
Polywell Poly 5100T3	5.6	6.3	6.4	6.1	611 KBps	193	62%	0	70%	0	74%	0	60%
Quantex OPS/100 M-4	4.5	5.0	4.9	5.0	612 KBps	193	61%	0	79%	346	100%	0	63%
Robotech Cobra XL P100	4.0	4.4	4.1	4.4	612 KBps	193	74%	0	74%	327	99%	0	78%
Robotech Cobra XLT P100	4.7	5.2	5.1	5.1	611 KBps	195	63%	0	57%	0	64%	0	59%
Sys Performance P100T	5.6	6.3	6.6	6.1	611 KBps	190	62%	0	55%	0	68%	0	59%
Tagram Thunderbolt P100	4.3	5.0	5.4	5.0	612 KBps	197	61%	0	67%	0	79%	0	57%
USA Flex Business Workstation	5.4	5.9	5.5	5.6	613 KBps	197	60%	0	74%	238	100%	0	67%

1 With an Action, Indeo, 320 x 240, 30-fps, 600-KBps clip. 2 With an Action, Indeo, 180 x 120, 30-fps, 300-KBps clip.
3 With an Action, Cinepak, 320 x 240 resolution, 30-fps, 300-KBps clip.

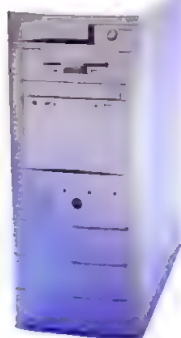
small-office/home-office users.

The Pentium/133-based QUIN-54M/P133 comes with a 1GB hard disk, a Toshiba quad-speed CD-ROM drive, a Diamond Stealth64 Video VRAM graphics board, and a 17-inch ADI monitor. But don't expect to hear big multimedia sound from this system: Although it comes with a Creative Labs Vibra 16 sound card, it doesn't support wavetable synthesis, and the tiny speakers offer voice-quality sound at best. The QUIN-54M/P133 also trailed its 133-MHz competitors in performance, turning in below-

average scores on Windows-based tests.

The QUIN-54M/P100 comes with basically the same equipment as the QUIN-54M/P133 but ships with a 15-inch Tatung monitor with built-in speakers. The system had average scores on all Windows-based benchmark tests.

Although both



DTK units came with 512K L2 cache, it is asynchronous. DTK admits to a further problem: The units' BIOS contains an error that gives the systems problems recognizing memory subsystem components. A newer revision of the BIOS remedies the problem, according to the vendor.

The DTK units have a two-year warranty; on-site service costs \$50 for one year.—JRW

DTK Computer Inc., City of Industry, CA; 800-289-2385, 818-810-0098; fax, 818-810-0090.

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Empac International

Saber P54-100

While Empac International's \$2,995 Saber P54-100 offers lots of expansion room in its tower case, it was a disappointing performer. Its benchmark test scores were even bested by those of some of the 90-MHz Pentium units tested. Empac sells mainly to corporate users but also serves individuals who need high-end machines.

The Saber P54-100 was a consistent underperformer on our benchmark tests, partly due to its reliance on asynchronous L2 cache, standard DRAM, and a Conner CFS1275A 1.2GB hard disk (a budget hard disk that will get the job done but is no speed demon). Its Winstone 96 score, one of the lowest in its CPU class, fell behind those of most

of the tested Pentium/90 units. The Saber logged in the lowest CD-ROM WinMark 96 score in this evaluation, the lowest Disk WinMark 96 score in its CPU class, and an average Graphics WinMark 96 score.

The Saber P54-100 comes with a quad-speed CD-ROM drive, a Creative Labs Sound Blaster 16 sound card, and a Dia-

mond Stealth64 Video VRAM graphics board to take care of your audio and graphics requirements. A 28.8-Kbps internal fax modem and an Optique 2000DC 15-inch monitor round out the hardware package.

For software, the unit came with game, educational, communications, and audio utility packages, including MPC Internet Wizard and Microsoft Encarta '95.

Empac offers a two-year parts and one-year labor warranty with the Saber P54-100; one year of on-site service costs \$125.—RSA

Empac International, Fremont, CA; 510-683-8800; fax, 510-683-8662.

Circle 485 on reader service card

EPS Technologies Inc.

**EPS Pinnacle P90,
EPS Pinnacle P133**

Although these two systems from direct marketer EPS—the \$3,399 EPS Pinnacle P133 and the \$2,699 EPS Pinnacle P90—offer extras like modems, bundled software suites, and 17-inch CTX monitors, neither managed banner benchmark test scores.

Both minitower systems come with 1GB Western Digital hard disks, Mitsumi quad-speed CD-ROM drives, and Turtle Beach Monte Carlo sound boards with FM synthesis support.

Heavy graphics users and DTP workers may be attracted to the 17-inch monitor and Number Nine 9FX Motion 771 graphics adapter with 4MB of VRAM that come with the Pinnacle P133. A 800MB Hewlett-Packard/Colorado Travan 1000 tape drive backs up essential files. EPS also includes an internal 28.8-/14.4-Kbps data/fax modem and a pair of Labtec speakers.

If you don't need all that horsepower, EPS offers a 90-MHz model, the EPS Pinnacle P90. It lacks the tape drive and comes with a 14.4-Kbps fax modem, less powerful speakers, and 2MB of VRAM on its Number Nine graphics accelerator card.

On our benchmark tests, the EPS P90 was an average performer. The P133 did not fare as well: It had an average Winstone 96 score but below-average Disk WinMark 96 and Graphics WinMark 96 scores. Both machines dropped a few frames in the video playback tests.

Software includes two solid packages: Quicken for Windows 8.0 and Novell's Professional PerfectOffice 3.0. EPS offers a three-year parts-and-labor warranty and one year of free on-site service.—JRQ

EPS Technologies Inc., Jefferson, SD; 800-447-0921, 605-966-5586; fax, 605-966-5482.

Circle 486 on reader service card

Ergo Computing Inc.

**ThunderBrick 100,
ThunderBrick 133**

Ergo Computing piles on the accessories to distinguish its Pentium systems. The \$3,495 top-of-the-line ThunderBrick 133, aimed at CAD users and software developers, and the \$3,195 midrange ThunderBrick 100, targeting the general business market, justify their prices with tape backup drives, 17-inch monitors, and extra software. Both were average performers and include an impressive four-year parts-and-labor warranty with four years of free on-site service and free 24-hour tech support.

Using identical Triton-based PCI/ISA motherboards housed in mini-tower cases, the ThunderBrick models come equipped with 1.2GB Conner IDE hard disks, Toshiba quad-speed CD-ROM drives, and Nokia 447L monitors with built-in speakers. Both systems also use ATI Mach 64 graphics cards with 2MB of DRAM and have Creative Labs' Vibra 16 audio chip sets installed on the motherboard. Home-office users will appreciate the preinstalled software, which includes Claris Works, Wealth Builder, askSAM, and Net Cruiser.

Included with the 133-MHz Pentium-based ThunderBrick 133 are an internal 28.8-/14.4-Kbps data/fax modem and a pair of self-powered speakers from Jazz Hipster Corp. The 100-MHz Pentium-based ThunderBrick 100 lacks these extras.

On our tests, both Ergo machines delivered mostly average performances within their respective CPU classes. The

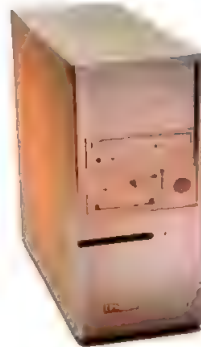
sole exception was each unit's below-average Disk WinMark 96 score. In both objective and subjective tests, the ThunderBricks passed *PC Magazine's* multimedia tests without difficulty.—JRQ

Ergo Computing Inc., Peabody, MA; 800-880-1925, 508-535-7510; fax, 508-535-7512.

Circle 487 on reader service card

**IN SHORT**

The Saber offers lots of expansion room and a fax modem but lacks performance.

**IN SHORT**

Both units offer fax modems, good sound cards, and 17-inch monitors.

**IN SHORT**

Ergo's machines offer respectable performance and a four-year warranty.

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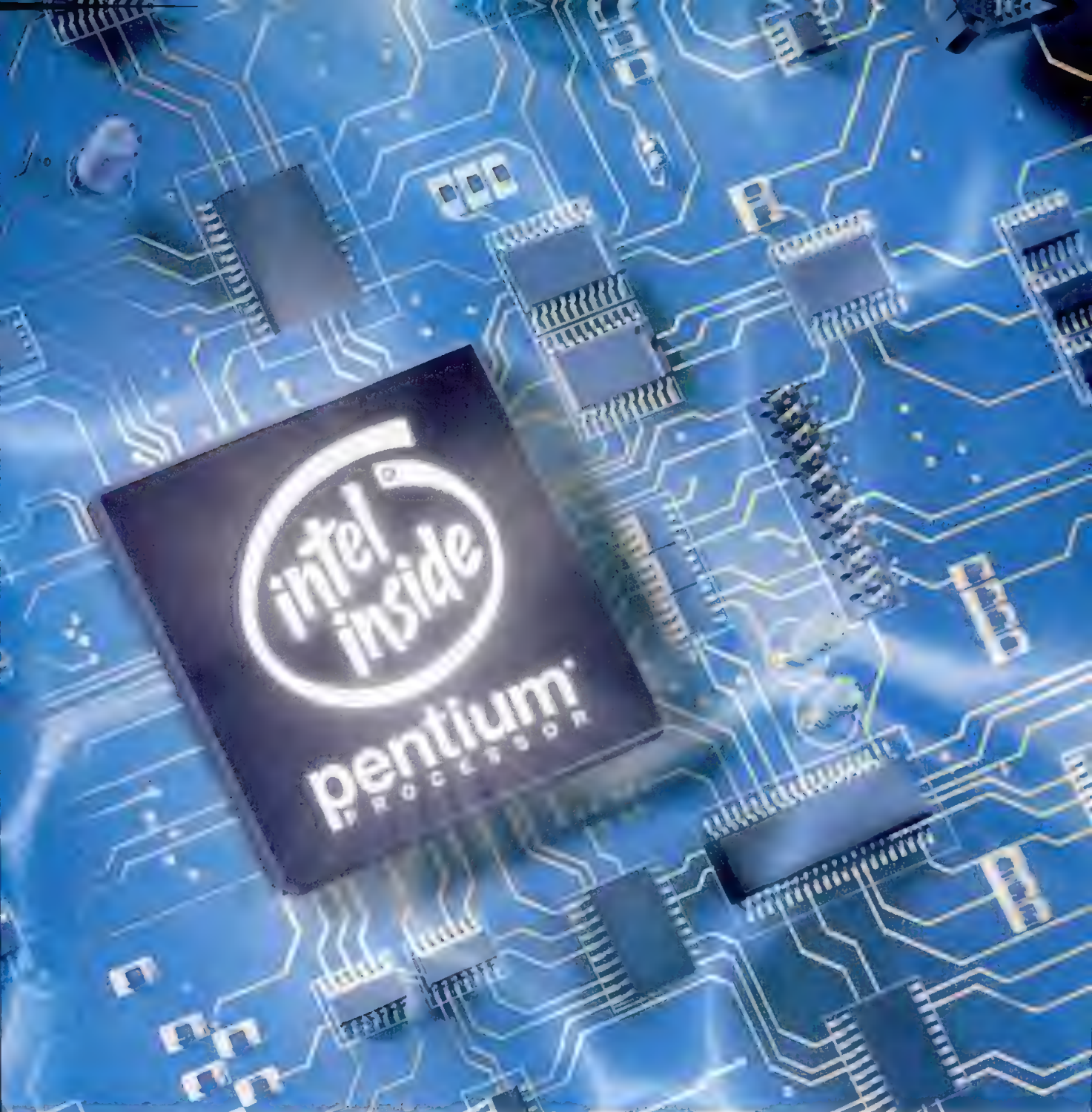


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Benchmark Tests: High-End Windows 95 Pentium PCs

What the Numbers Mean

For this roundup, we defined high-end PCs as systems running with either 120-MHz or 133-MHz Pentium CPUs. Here is where you are most likely to see all the bells and whistles a vendor can add, such as 4MB of memory on graphics cards and wavetable-synthesis audio boards. On the average, you can expect about 18 percent more performance from these systems than from the midrange PCs.

WINSTONE 96

Of the five Pentium/120 machines we tested for this roundup, the PacTron DaytonaWin-120NX garnered the best Winstone 96 score. Key components that helped this system achieve its lofty score were its fast Enhanced-IDE Conner CFA 1275A hard disk and its PCI-based Diamond Stealth64 Video VRAM graphics accelerator card.

As a group, the Pentium/120 PCs that we tested could have performed better. The subsystems that these machines used were not the fastest we've seen. In fact, the top-scoring Pentium/100-powered PCs here performed better than the average Pentium/120 on our Winstone tests. This implies that better CPU and memory-subsystem tuning would lead to better performance. Another factor possibly affecting these scores was bus speed: While a Pentium/120's bus runs at 60 MHz, a Pentium/100's bus runs at a speedier 66 MHz. This difference may be particularly evident during disk- or graphics-intensive tasks.

Vendors' choices of hard disks in the Pentium/120 field also were not optimal. Our tests have shown that the Quantum Fireball is the fastest IDE hard disk around. With additional tuning and faster subsystem choices, you should be able to boost overall system performance.

The best Pentium/133s combined synchronous L2 cache, fast EIDE or SCSI-2 hard disks, and 64-bit graphics accelerators. The top-scoring Hertz P133e used 512K of 8-ns pipelined-burst L2 cache and EDO DRAM for a powerful memory subsystem. Its 2GB Seagate SCSI-2 hard disk, connected to an Adaptec AHA-2940W controller, proved unbeatable. Finally, it used an ATI Graphics Pro Turbo card with 4MB of VRAM to help its graphics performance. These components combined to give the Hertz PC the highest Winstone 96 score among systems running Windows 95.

GRAPHICS WINMARK 96

In the Graphics WinMark 96 arena, we witnessed a performance coup orchestrated by the Matrox Millennium graphics card: The majority of the top-scoring Pentium 133s used this board. Powered by their new MGA-2064W 64-bit graphics engines, these cards made an excellent showing.

Tied for third on our Graphics WinMark tests among Pentium/133s was the Tangent MediaStar 5133/95, which used an STB Powergraph 64 graphics card, based on the new Trio64V+ graphics engine. As with the Tangent 590/95, we tested the MediaStar 5133/95 with a vendor-supplied graphics card driver instead of the Windows 95 minidriver, because Windows 95 does not yet support the Trio64V+ chip set. It is

possible that STB was able to tune its driver enough to give the Powergraph 64 a performance edge on our tests.

DISK WINMARK 96

Among Pentium/133s, top Disk WinMark 96 scores were posted by machines using hard disks with the fastest disk-rotational speeds. The two speediest SCSI disks—the Seagate ST32550W in the Hertz P133e and the Quantum GrandPrix XP32151S in the Micron P133 Millennium Plus—have disk-rotational speeds of 7,200 rpm (which compares with the 5,400-rpm speeds of other SCSI disks). The two top-scoring EIDE hard disks—the Quantum Fireball 1080A in the Polywell Poly 5133T3 and the Western Digital Caviar 31600H in the NEC PowerMate P133—had rotational speeds of 5,400 rpm (most EIDE disks spin at 4,500 rpm or slower).

Rotational speed affects disk performance more than any other factor. Higher rotational velocity translates into less latency and faster data-transfer rates—two issues that figure significantly in our benchmark tests and in everyday performance as well. The slowest disk was the EIDE Conner CFS 1275A, found in the Tatung UNIQ 5210 Pentium 120 and the Ergo ThunderBrick 133. The CFS 1275A is a reasonably priced alternative with a rotational speed of 3,600 rpm (not to be confused with the Conner CFA 1275A, which spins at 4,500 rpm).

CPUMARK₁₆ AND CPUMARK₃₂

Synchronous or pipelined-burst synchronous L2 cache, and how much of it is used, made the difference on our CPUmark tests. The small sampling of Pentium/120 PCs produced somewhat misleading CPUmark scores. The top-scoring Compaq ProLinea 5120 barely beat out the top Pentium/100 units. This discrepancy may also be due to the Pentium/100 systems' CPU-to-memory bus speed, which is 66 MHz (which compares with Pentium/100 PCs' 60-MHz bus speed). The Compaq ProLinea 5120 used 256K of pipelined-burst cache and a Compaq core-logic chip set.

The larger group of Pentium/133 PCs gave a more definitive answer. The top seven units each used 512K of synchronous or pipelined-burst L2 cache, EDO DRAM, and Intel's Triton chip set. It was this extra L2 cache that gave them a boost, allowing them to outperform the other Pentium/133s.

CD-ROM WINMARK 96

CD-ROM WinMark 96 scores closely tracked CD-ROM drive speed, with 6X drives producing the highest scores, followed by 4.4X drives. Quad-speed drives turned in the lowest scores. In the 6X arena, machines with Plextor PX-63CS SCSI-2 6X drives came out on top, followed closely by units with TEAC's CD-56E 6X ATAPI drives.

CD-ROM SEQUENTIAL 16K READ

This test uses 16K-block-size sequential reads from the CD-ROM. The results should be fairly close to the CD-ROM's rated speed. In this group, all the CD-ROM drives lived up to their ratings.

WINSTONE 96

Score ► 0 10 20 30 40 50 60 70

Pentium/120 systems

Compaq ProLinea 5120	51
MidWest Micro P5-120 Office PC	53
MITAC Performance Series 120	49
PacTron DaytonaWin-120NX	54
Tatung UNIQ 5210 Pentium 120	45

Pentium/133 systems

Aberdeen P133-PCI	62
ACMA z-Power 133	63
ACW Pentium P5-133B	61
AMAX P133 Powerstation	60
Compaq Deskpro XL 5133	49
Comtrade Multimedia Dream Machine	63
Data Storage DataStor P5-133	65
Dell Dimension XPS P133c	65
DFI Landmarq P133VPM	53
Diamond Office Master DT133	65
Digital Celebris XL 5133	60
DirectWave Blue Thunder PT5P133B	62
DTK QUIN-54M/P133	51
EPS Pinnacle P133	55
Ergo Thunderbrick 133	61
Gateway 2000 P5-133 Best Buy	53
GST Aapogee 133	50
Hertz P133e	69
HiQ Apollo P133	62
IPC Austin PowerPlus 133	68
Initiative Technology ITI 5133	51
Maximus Magna Graphics ProMedia	68
Mega Impact 5133PC116MT	63
Micron P133 Millennia Plus	61
Mitsuba Executive P-133	51
Multiwave Ultra Power 133	60
NEC PowerMate P133	67
PerComp P133 Professional	58
Polywell Poly 5133T3	64
Premio Express Station P133	68
Quantex QP5/133 SM-2	64
Robotech Cobra XL P133	46
Robotech Cobra XLT P133	56
SMD Mount Shasta	67
Sys Performance P133T	63
Tagram Thunderbolt P133	55
Tangent MediaStar 5133/95	67
Unisys PW ² CWP 51336	58
Unitex Thunderstreak Pentium 133	62
Vektron Ultimate Power Station P133	62
Wedge DeskMate Pro 133	64

WORST

BEST

GRAPHICS WINMARK 96

Score ► 0 5 10 15 20 25

Pentium/120 systems

Compaq ProLinea 5120	11.1
MidWest Micro P5-120 Office PC	15.4
MITAC Performance Series 120	15.7
PacTron DaytonaWin-120NX	19.3
Tatung UNIQ 5210 Pentium 120	11.0

Pentium/133 systems

Aberdeen P133-PCI	21.9
ACMA z-Power 133	20.6
ACW Pentium P5-133B	21.7
AMAX P133 Powerstation	21.3
Compaq Deskpro XL 5133	15.8
Comtrade Multimedia Dream Machine	21.0
Data Storage DataStor P5-133	20.9
Dell Dimension XPS P133c	20.9
DFI Landmarq P133VPM	15.9
Diamond Office Master DT133	18.1
Digital Celebris XL 5133	22.5
DirectWave Blue Thunder PT5P133B	21.2
DTK QUIN-54M/P133	17.9
EPS Pinnacle P133	17.6
Ergo Thunderbrick 133	21.2
Gateway 2000 P5-133 Best Buy	24.4
GST Aapogee 133	15.0
Hertz P133e	20.9
HiQ Apollo P133	21.3
IPC Austin PowerPlus 133	21.0
Initiative Technology ITI 5133	24.1
Maximus Magna Graphics ProMedia	20.4
Mega Impact 5133PC116MT	21.2
Micron P133 Millennia Plus	22.0
Mitsuba Executive P-133	17.6
Multiwave Ultra Power 133	21.1
NEC PowerMate P133	18.3
PerComp P133 Professional	21.2
Polywell Poly 5133T3	21.5
Premio Express Station P133	20.9
Quantex QP5/133 SM-2	18.5
Robotech Cobra XL P133	12.0
Robotech Cobra XLT P133	20.4
SMD Mount Shasta	20.1
Sys Performance P133T	21.1
Tagram Thunderbolt P133	24.8
Tangent MediaStar 5133/95	22.5
Unisys PW ² CWP 51336	17.5
Unitex Thunderstreak Pentium 133	20.4
Vektron Ultimate Power Station P133	21.1
Wedge DeskMate Pro 133	21.3

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CD-ROM ACCESS TIME

For this test, comparisons are possible only among identical drives within a processor group, and lower scores are preferable. Access times posted by systems with identical CPUs and CD-ROM drives were within a few points of each other.

CD-ROM CPU UTILIZATION

CPU utilization can only be compared across same-speed CD-ROM drives. Lower scores are preferable, because the CPU has more time to service other requests during active-data-transfer sessions from the CD-ROM drive.

You'll notice our results show that faster drives produce higher CPU-utilization scores. These drives, however, accomplish more work in a shorter period of time than slower drives

when transferring certain kinds of data (when performing image loads, program loads, or searches, for example).

VIDEO DATA RATE AND SCALING

To test video performance, we used .AVI clips with different data rates, as well as a clip that scales to full screen. We used the 32-bit Indeo and Cinepak codecs included with Windows 95. In general, if a PC is using properly installed CD-ROM components and the proper 32-bit Windows 95 drivers, then it should complete these tests, dropping few if any frames.

The Robotech Cobra XL P133 used a real-mode driver for its hard disk. This caused a conflict with its ATAPI (IDE) CD-ROM drive, which most likely led to its high number of dropped frames and poor performance.

DISK WINMARK 96

Score ► 0 200 400 600 800 1,000 1,200

Pentium/120 systems

Compaq ProLinea 5120	778
MidWest Micro P5-120 Office PC	905
MITAC Performance Series 120	822
PacTron DaytonaWin-120NX	956
Tatung UNIQ 5210 Pentium 120	589

Pentium/133 systems

Aberdeen P133-PCI	1,050
ACMA z-Power 133	1,110
ACW Pentium P5-133B	948
AMAX P133 Powerstation	870
Compaq Deskpro XL 5133	1,030
Contrade Multimedia Dream Machine	1,120
Data Storage DataStor P5-133	927
Dell Dimension XPS P133c	1,030
DFI Landmarq P133VPM	697
Diamond Office Master DT133	1,130
Digital Celebris XL 5133	978
DirectWave Blue Thunder PT5P133B	1,120
DTK QUIN-54M/P133	833
EPS Pinnacle P133	841
Ergo Thunderbrick 133	660
Gateway 2000 P5-133 Best Buy	1,020
GST Aapogee 133	977
Hertz P133a	1,180
HiQ Apollo P133	1,050
IPC Austin PowerPlus 133	1,080
Initiative Technology ITI 5133	1,030
Maximus Magna Graphics ProMedia	1,040
Mega Impact 5133PCI16MT	1,030
Micron P133 Millennia Plus	1,120
Mitsuba Executive P-133	1,020
Multiwave Ultra Power 133	882
NEC PowerMate P133	1,040
PerComp P133 Professional	885
Polywell Poly 5133T3	1,150
Premio Express Station P133	1,120
Quantex QP5/133 SM-2	1,020
Robotech Cobra XL P133	709
Robotech Cobra XLT P133	922
SMD Mount Shasta	1,040
Sys Performance P133T	1,130
Tagram Thunderbolt P133	1,120
Tangent MediaStar 5133/95	1,050
Unisys PW ² CWP 51336	959
Unittek Thunderstreak Pentium 133	1,010
Vektron Ultimate Power Station P133	1,050
Wedge DeskMate Pro 133	1,050

WORST

BEST

CPUMARK16

Score ► 0 50 100 150 200 250 300

Pentium/120 systems

Compaq ProLinea 5120	238
MidWest Micro P5-120 Office PC	205
MITAC Performance Series 120	201
PacTron DaytonaWin-120NX	230
Tatung UNIQ 5210 Pentium 120	221

Pentium/133 systems

Aberdeen P133-PCI	293
ACMA z-Power 133	273
ACW Pentium P5-133B	289
AMAX P133 Powerstation	274
Compaq Deskpro XL 5133	255
Contrade Multimedia Dream Machine	279
Data Storage DataStor P5-133	270
Dell Dimension XPS P133c	278
DFI Landmarq P133VPM	235
Diamond Office Master DT133	268
Digital Celebris XL 5133	246
DirectWave Blue Thunder PT5P133B	277
DTK QUIN-54M/P133	243
EPS Pinnacle P133	228
Ergo Thunderbrick 133	276
Gateway 2000 P5-133 Best Buy	269
GST Aapogee 133	207
Hertz P133a	291
HiQ Apollo P133	274
IPC Austin PowerPlus 133	275
Initiative Technology ITI 5133	280
Maximus Magna Graphics ProMedia	271
Mega Impact 5133PCI16MT	282
Micron P133 Millennia Plus	272
Mitsuba Executive P-133	222
Multiwave Ultra Power 133	277
NEC PowerMate P133	274
PerComp P133 Professional	278
Polywell Poly 5133T3	276
Premio Express Station P133	274
Quantex QP5/133 SM-2	276
Robotech Cobra XL P133	203
Robotech Cobra XLT P133	261
SMD Mount Shasta	270
Sys Performance P133T	290
Tagram Thunderbolt P133	277
Tangent MediaStar 5133/95	286
Unisys PW ² CWP 51336	241
Unittek Thunderstreak Pentium 133	228
Vektron Ultimate Power Station P133	289
Wedge DeskMate Pro 133	292

WORST

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How We Tested

We tested all PCs with 1GB or larger hard disks, quad-speed or faster CD-ROM drives, 16-bit sound boards, and 16MB of RAM. We used each vendor's pre-installed graphics driver for 1,024-by-768 resolution with 256 colors, small fonts, and a refresh rate of 75 Hz. We also disabled power management features and removed unnecessary drivers. Hard disks were defragmented before each test.

On systems running Microsoft Windows 3.1 or Windows for Workgroups 3.11, we enabled SMARTDRV.EXE in write-back mode with a cache size of 4MB and a 20MB permanent swap file. On Windows for Workgroups PCs, we set up a 32-bit file cache of 4MB and allowed Windows to shrink the SmartDrive cache to 128K. On systems running Microsoft Windows 95, we let Windows 95 manage the virtual memory settings.

We used Winstone 96, Version 1.0, to measure the units' performance when running typical Windows applications. Winstone 96 measures the time

a PC takes to execute a set of scripts that exercise 13 of the best-selling Windows 3.1 applications. Winstone 96 weights a given PC's test timings based on the applications' unit market shares; it derives a composite number and converts it to a relative score. (Relative to the performance of a 486SX/25 Dell 425s/P with 8MB of RAM, whose score is defined as 10.) We also present Winstone 96 scores for four categories of applications: Spreadsheet, Word Processing, Database, and Business Graphics/DTP. (Each score is relative to the Dell 425s/P, whose score is defined as 1.)

We used WinBench 96, Version 1.0, as a measure of graphics, disk, processor, CD-ROM, and motion-video performance under Windows. The Graphics WinMark 96 portion of WinBench produces a number based on 115 tests of Windows GDI (Graphics Device Interface) functions and represents performance of each machine's graphics subsystem under Windows. The Disk WinMark 96 score, a harmonic mean based on extensive application profiling,

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CPUMARK₃₂

Score ► 0 50 100 150 200 250 300

Pentium/120 systems

Compaq ProLinea 5120	239
MidWest Micro P5-120 Office PC	195
MiTAC Performance Series 120	192
PacTron DaytonaWin-120NX	228
Tatung UNIQ 5210 Pentium 120	215

Pentium/133 systems

Aberdeen P133-PCI	299
ACMA z-Power 133	276
ACW Pentium P5-133B	299
AMAX P133 Powerstation	276
Compaq Deskpro XL 5133	240
Comtrade Multimedia Dream Machine	276
Data Storage DataStor P5-133	271
Dell Dimension XPS P133c	275
DFI Landmarq P133VPM	224
Diamond Office Master DT133	270
Digital Celebris XL 5133	239
DirectWave Blue Thunder PT5P133B	281
DTK QUIN-54M/P133	237
EPS Pinnacle P133	222
Ergo Thunderbrick 133	275
Gateway 2000 P5-133 Best Buy	279
GST Aapogee 133	202
Hertz P133e	258
HiQ Apollo P133	276
IPC Austin PowerPlus 133	276
Initiative Technology ITI 5133	278
Maximus Magna Graphics ProMedia	274
Mega Impact 5133PCI16MT	288
Micron P133 Millennia Plus	274
Mitsuba Executive P-133	219
Multiwave Ultra Power 133	280
NEC PowerMate P133	275
PerComp P133 Professional	278
Polywell Poly 5133T3	282
Premio Express Station P133	271
Quantex QP5/133 SM-2	275
Robotech Cobra XL P133	193
Robotech Cobra XLT P133	262
SMD Mount Shasta	264
Sys Performance P133T	299
Tagram Thunderbolt P133	283
Tangent MediaStar 5133/95	300
Unisys PW ² CWP 51336	236
Unitek Thunderstreak Pentium 133	222
Vektron Ultimate Power Station P133	297
Wedge DeskMate Pro 133	300

WORST

BEST

represents the disk subsystem's performance under Windows.

The CPUmark₁₆ and CPUmark₃₂ scores are numbers indicating the speed of a PC's processor subsystem under 16-bit and 32-bit Windows operating systems, respectively. WinBench 96 bases these scores on large instruction mixes that emulate the CPU activity of real-world applications. The processor subsystem includes the CPU, external processor cache, and system memory.

The CD-ROM WinMark 96 score gauges the performance of the machines' CD-ROM subsystem, which includes the CD-ROM drive, its adapter, and its required software drivers. This number is based on a profile of six of today's most popular Windows 3.1 CD-ROM applications in three categories: business and productivity; games and entertainment; and reference and education.

We report the results of the CD-ROM Sequential 16K Read, which measures the throughput of the CD-ROM subsystem when reading 16K blocks of data on a CD-ROM. The Access Time score measures the CD-ROM drive's

CD-ROM WINMARK 96

Score ► 0 100 200 300 400 500 600 700

Pentium/120 systems

Compaq ProLinea 5120	447
MidWest Micro P5-120 Office PC	437
MiTAC Performance Series 120	438
PacTron DaytonaWin-120NX	367
Tatung UNIQ 5210 Pentium 120	362

Pentium/133 systems

Aberdeen P133-PCI	433
ACMA z-Power 133	517
ACW Pentium P5-133B	438
AMAX P133 Powerstation	527
Compaq Deskpro XL 5133	431
Comtrade Multimedia Dream Machine	417
Data Storage DataStor P5-133	363
Dell Dimension XPS P133c	585
DFI Landmarq P133VPM	429
Diamond Office Master DT133	368
Digital Celebris XL 5133	378
DirectWave Blue Thunder PT5P133B	438
DTK QUIN-54M/P133	422
EPS Pinnacle P133	410
Ergo Thunderbrick 133	442
Gateway 2000 P5-133 Best Buy	417
GST Aapogee 133	395
Hertz P133e	440
HiQ Apollo P133	442
IPC Austin PowerPlus 133	613
Initiative Technology ITI 5133	608
Maximus Magna Graphics ProMedia	423
Mega Impact 5133PCI16MT	436
Micron P133 Millennia Plus	615
Mitsuba Executive P-133	470
Multiwave Ultra Power 133	605
NEC PowerMate P133	237
PerComp P133 Professional	403
Polywell Poly 5133T3	431
Premio Express Station P133	368
Quantex QP5/133 SM-2	442
Robotech Cobra XL P133	373
Robotech Cobra XLT P133	426
SMD Mount Shasta	410
Sys Performance P133T	481
Tagram Thunderbolt P133	584
Tangent MediaStar 5133/95	365
Unisys PW ² CWP 51336	426
Unitek Thunderstreak Pentium 133	440
Vektron Ultimate Power Station P133	413
Wedge DeskMate Pro 133	453

WORST

BEST

speed while randomly accessing 2K files from the entire CD-ROM.

We also use the CD-ROM CPU Utilization score to measure the percentage of the processor's bandwidth occupied by servicing the CD-ROM subsystem while it retrieves data in default block sizes of 16K. The transfer rate defaults to the maximum transfer rate of your particular CD-ROM subsystem. WinBench 96 then calculates this transfer rate before it runs the actual test.

WinBench 96 also includes Video Test, a test suite composed of 33 video clips to measure the PC's ability to play full-motion .AVI video files. We report results from the Video Data Rate tests, which use the Action, Indeo, 320-by-240, 30-fps, 600-Kbps video clip; the Full-Screen Video Scale tests, which use the Action, Indeo, 160-by-120, 30-fps, 300-Kbps video clip; and the Video Matrix tests, which use the Action, Cinepak 320-by-240, 30-fps, 300-Kbps video clip. We report two results: the number of frames dropped while playing each video clip, and the CPU utilization, which measures the percentage of CPU resources used to run each clip.



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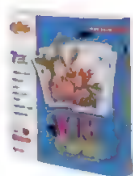
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	WINSTONE 96				CD-ROM			VIDEO DATA RATE ¹		FULL-SCREEN VIDEO SCALE ²		VIDEO MATRIX ³	
	Spread-sheet	Word Processing	Database	Business Graphics/DTP	Sequential 16K Read	Access Time (ms)	CPU Utilization	Frames Dropped	CPU Utilization	Frames Dropped	CPU Utilization	Frames Dropped	CPU Utilization
Pentium/120 systems													
Compaq ProLinea 5120	4.0	5.0	5.0	6.0	613 KBps	221	44%	0	70%	0	75%	0	40%
MidWest Micro P5-120 Office PC	5.0	6.0	6.0	6.0	680 KBps	232	52%	0	94%	289	99%	0	39%
MiTAC Performance Series 120	5.0	5.0	5.0	5.0	612 KBps	220	49%	0	80%	0	79%	0	55%
PacTron DaytonaWin-120NX	5.0	6.0	6.0	6.0	612 KBps	293	37%	0	57%	0	64%	0	45%
Tatung UNIQ 5210 Pentium 120	4.0	5.0	4.0	5.0	610 KBps	300	47%	0	80%	0	79%	0	58%
Pentium/133 systems													
Aberdeen P133-PCI	5.7	6.5	6.6	6.4	612 KBps	203	62%	0	90%	0	91%	0	59%
ACMA z-Power 133	5.6	6.5	6.8	6.6	917 KBps	206	59%	0	62%	0	66%	0	44%
ACW Pentium P5-133B	5.6	6.4	6.4	6.3	612 KBps	194	61%	0	76%	0	82%	0	59%
AMAX P133 Powerstation	5.4	6.3	6.2	6.3	917 KBps	204	46%	0	64%	0	80%	0	45%
Compaq Deskpro XL 5133	4.3	5.2	5.3	5.0	612 KBps	193	24%	0	85%	0	89%	0	58%
Comtrade Dream Machine	5.6	6.5	6.7	6.5	614 KBps	260	34%	352	99%	59	99%	0	56%
Data Storage DataStor P5-133	6.0	6.9	6.6	6.6	613 KBps	305	40%	0	81%	0	87%	0	48%
Dell Dimension XPS P133c	5.9	6.9	6.7	6.5	918 KBps	196	46%	14	99%	376	99%	0	42%
DFI Landmark P133VPM	5.0	5.8	5.1	5.5	613 KBps	194	59%	0	76%	0	83%	0	49%
Diamond Office Master DT133	5.8	6.8	6.9	6.7	612 KBps	293	37%	0	95%	359	99%	0	45%
Digital Celebris XL 5133	5.6	6.4	6.1	6.0	522 KBps	189	68%	0	76%	0	80%	0	64%
DirectWave Blue Thunder PT5P133B	5.6	6.5	6.6	6.4	612 KBps	187	63%	0	86%	0	90%	0	44%
DTK QUIN-54M/P133	4.7	5.4	5.1	5.4	611 KBps	190	63%	0	78%	0	77%	0	74%
EPS Pinnacle P133	5.1	5.8	5.5	5.7	613 KBps	243	38%	0	80%	0	79%	0	61%
Ergo Thunderbrick 133	5.7	6.6	5.9	6.1	613 KBps	187	62%	23	99%	77	99%	0	66%
Gateway 2000 P5-133 Best Buy	4.7	5.5	5.6	5.8	613 KBps	237	38%	0	88%	0	97%	0	53%
GST Apogee 133	4.5	5.1	5.2	5.3	612 KBps	207	63%	0	78%	0	78%	0	56%
Hertz P133e	6.3	7.3	7.0	7.0	613 KBps	189	61%	0	78%	0	84%	0	45%
HiQ Apollo P133	5.6	6.5	6.6	6.4	612 KBps	191	61%	0	55%	0	62%	0	66%
IPC Austin PowerPlus 133	6.2	7.3	7.1	6.8	911 KBps	154	40%	0	86%	0	91%	0	59%
Initiative Technology IT1 5133	4.4	5.4	5.5	5.3	910 KBps	155	39%	0	77%	0	76%	0	60%
Maximus Magna Graphics ProMedia	6.2	7.2	7.0	6.8	920 KBps	267	61%	0	85%	0	86%	0	40%
Mega Impact 5133PCI16MT	5.7	6.5	6.7	6.5	612 KBps	190	63%	0	78%	0	93%	0	44%
Micron P133 Millennia Plus	5.6	6.4	6.4	6.2	91 KBps	152	47%	3	59%	0	76%	0	56%
Mitsuba Executive P-133	4.5	5.4	5.3	5.5	675 KBps	163	31%	0	58%	0	68%	0	63%
Multiwave Ultra Power 133	5.5	6.4	5.8	6.2	919 KBps	172	40%	0	61%	0	65%	0	55%
NEC PowerMate P133	6.1	7.0	7.0	6.8	917 KBps	211	76%	0	65%	0	75%	0	40%
PerComp P133 Professional	5.3	6.2	5.9	5.9	611 KBps	210	59%	0	69%	0	70%	0	46%
Polywell Poly 5133T3	5.8	6.6	6.7	6.5	611 KBps	191	61%	0	81%	0	88%	0	57%
Premio Express Station P133	6.2	7.2	7.1	7.0	610 KBps	228	55%	0	58%	0	67%	0	60%
Quantex OP5/133 SM-2	5.7	6.7	6.7	6.5	611 KBps	189	62%	0	76%	0	73%	0	61%
Robotech Cobra XL P133	4.2	4.9	4.4	4.9	613 KBps	206	98%	0	65%	0	77%	0	74%
Robotech Cobra XLT P133	5.2	5.9	5.5	5.9	613 KBps	189	62%	0	67%	0	81%	0	60%
SMD Mount Shasta	6.3	7.0	7.0	6.7	612 KBps	211	62%	0	89%	0	95%	0	60%
Sys Performance P133T	5.7	6.6	6.6	6.5	674 KBps	158	35%	0	64%	0	77%	0	51%
Tagram Thunderbolt P133	4.9	5.6	6	5.8	919 KBps	191	46%	0	87%	0	84%	0	38%
Tangent MediaStar 5133/95	6.2	7.1	6.8	6.7	613 KBps	304	42%	0	86%	267	99%	0	49%
Unisys PW ² CWP 51336	5.4	6.1	6.0	5.9	611 KBps	192	62%	0	76%	0	76%	0	65%
Unitek Thunderstreak Pentium 133	5.5	6.4	6.5	6.4	612 KBps	187	63%	0	86%	236	99%	0	57%
Vektron Ultimate P133	5.7	6.5	6.5	6.4	613 KBps	205	60%	0	86%	36	99%	0	58%
Wedge DeskMate Pro 133	5.9	6.6	6.7	6.6	611 KBps	235	34%	0	75%	0	84%	0	40%

¹ With an Action, Indeo, 320 x 240, 30-fps, 600-KBps clip. ² With an Action, Indeo, 160 x 120, 30-fps, 300-KBps clip.
³ With an Action, Cinepak, 320 x 240 resolution, 30-fps, 300-KBps clip.

Gateway 2000 Inc.

Gateway 2000 P5-100, Gateway 2000 P5-133 Best Buy

The Gateway 2000 P5-133 Best Buy is a \$3,758 133-MHz tower system decked out for advanced multimedia use; the Gateway 2000 P5-100 is a 100-MHz entry-level \$3,267 desktop system.

Both packages generate positive out-of-box experiences, but neither live up to performance expectations.

Both of the Gateway systems come with 17-inch Sony Trinitron-based monitors and 28.8-Kbps modems. For audio chores, the PCs use Creative Labs' Vibra 16 cards and Altec Lansing's ACS 5 speakers.

Gateway offers users a choice of two software bundles. For business users,

there's Microsoft Office Professional for Windows 95, which includes Word and Excel. For the home user, there's a nine-CD-ROM package (51 titles in all) that includes Microsoft Works and Cinemania 95.

The P5-133 Best Buy includes a 1.5GB hard disk and a Matrox graphics card with 2MB of WRAM. The P5-133 had an above-average Graphics WinMark 96 score, an average Disk WinMark 96 score,

You're ready to make the move to Microsoft's new 32-bit Windows 95 operating system. The most powerful PC operating system you've

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background, monitoring your system and automatically launching tools to maintain system performance and prevent system crashes. Of course, if your system does

crash or you accidentally erase a file, Norton Utilities for Windows 95 gives you the data recovery tools users have relied on from day one.

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Frees up disk space and provides a comprehensive pre-installation physical.

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Continuously monitors all vital resources and data integrity. Alerts you to impending disaster and recommends action or fixes problems automatically.

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Automatically diagnoses and repairs file system problems using the speed and safety of 32-bit technology.

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100% protection of erased files. The new wizard-like interface leads you through file recovery step by step.

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Diagnoses potential conflicts and configuration problems with detailed system information and performance testing.

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Automatically optimizes drives and reduces future fragmentation using 32-bit technology.



continuous, real-time protection and data recovery in the brave new world of Windows 95.

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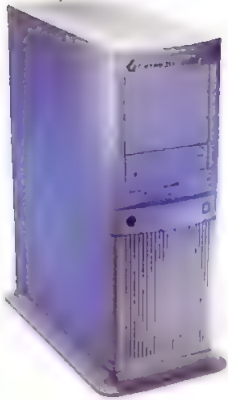
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SYMANTEC.

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CIRCLE 374 ON READER SERVICE CARD



IN SHORT

Poor Winstone performance mars these generally well-equipped units.

SERVICE & RELIABILITY
Gateway 2000 Inc.

Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Average

GST/Micro City Inc.
Aapogee 133

The GST/Micro City Aapogee 133 system proves that just bundling together top-flight parts won't necessarily get you into orbit. At a direct sales price of \$2,489, the Aapogee 133 provides quality system parts, but Windows 95 performance was sluggish.

The midsize tower comes with many of the same components seen in competing machines. The Aapogee 133 is based on a 133-MHz Pentium processor with a Triton chip set, EDO DRAM, and a whopping 512K of pipelined-burst L2 cache. Furthermore, GST uses a 1GB Quantum Fireball hard disk and a Diamond

and a below-average Winstone 96 score.

The P5-100 came in dead last on our Winstone tests in its class: The absence of L2 processor cache is the main culprit here. The Disk WinMark and Graphics WinMark scores were average.

Gateway offers a three-year parts and one-year labor warranty including one year of on-site service and lifetime tech support for all Gateway-sold software.—JRQ

Gateway 2000 Inc., N. Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023.

Circle 470 on reader service card



IN SHORT

Despite good components, the Aapogee fails to deliver on performance.

Stealth64 Video VRAM graphics accelerator card with 2MB of VRAM.

These high-powered components did not translate into rocketing performance for the Aapogee 133. Its top score was an average Disk WinMark 96 result; its Graphics WinMark 96 score was below average. Consequently, it turned in one of the lowest Winstone results in this roundup.

Fortunately, multimedia video playback was not affected. A quad-speed Toshiba CD-ROM drive and a motherboard-bound Creative Labs Vibra 16 chip set reliably handle video clips and sound. Most buyers will want something more than the included 15-inch Aurora Vision monitor and the raw EP-280 external speakers, however.

GST/Micro City offers a one-year parts-and-labor warranty with the Aapogee 133. On-site service is \$49 for one year.—JRQ

GST/Micro City Inc., Cerritos, CA; 800-567-2764, 714-739-0106; fax, 714-739-8291.

Circle 488 on reader service card

Hertz Computer Corp.

Hertz P90e,
Hertz P133e

The \$4,250 Hertz P133e was loaded up with fast components, and it paid off. The P133e, aimed at engineers and high-end graphics users, was the best performing 133-MHz Pentium system in this roundup. And Hertz offers the \$2,295 Hertz P90e for the cost-conscious buyer.

Both machines are based on an ASUS-tek ISA/PCI-based motherboard. One of the PCI slots has a proprietary MediaBus extension, which can accommodate a graphics/sound card. The machines also come with 28.8-/14.4-Kbps data fax modems.

Hertz stacks the P133e with an ATI Mach 64 card with 4MB of VRAM, a 17-inch monitor, a Sound Blaster 16 audio card and a Cogent Emaster PCI Ethernet adapter. The system's 512K of pipelined-burst L2 cache, EDO DRAM, and removable 2GB Seagate Fast/Wide SCSI-2 hard disk push the P133e into the lead on our Winstone 96 test. The P133e had a top five Disk WinMark 96 score

and an average Graphics WinMark 96 score.

The P90e uses a 1GB Seagate EIDE hard disk, standard DRAM, and asynchronous L2 cache. An ASUS PCI-AV264CT combination graphics sound adapter card with 1MB of DRAM occupies the MediaBus slot.

The 90-MHz unit's Disk WinMark and Winstone test scores were average. The Graphics WinMark test score was one of the lowest in this roundup, most likely because of the combination graphics/sound card.

Hertz offers a one-year parts-and-labor warranty, on-site service included.—JRQ
Hertz Computer Corp., New York, NY; 800-232-8737, 212-684-4141; fax, 212-684-3658.

Circle 489 on reader service card

HiQ Computer Systems

Saturn P100,
Apollo P133

Both the \$3,260 Apollo P133 and the \$2,349 Saturn P100 are aimed at high-end business and home users. Since 1987, HiQ Computer Systems has sold directly to a corporate customer base, though the vendor will cater to individual buyers.

The tower-cased Apollo P133 came with a 1.5GB Western Digital Caviar IDE hard disk and a Toshiba quad-speed CD-ROM drive. Its drive bays used rails, which makes devices easy to install and remove. The Intel Triton-based motherboard offered an integrated 16-bit FM synthesis audio system as well as a Diamond Stealth64 Video VRAM graphics card with 2MB of VRAM, as well as a U.S. Robotics 28.8-/14.4-



IN SHORT

The P133e offers top performance. The P90e is for the budget-conscious only.



Windows 95 is here. And it's really terrific.

Except for one thing: it doesn't include any anti-virus protection. And your old anti-virus software won't work in Windows 95 either. But thousands of old viruses will.

So that leaves you with a choice. Do nothing and hope you never come across an infected floppy or download an infected file. Or buy a new anti-virus software product that

from the viruses everybody already knows about.

But also from the new viruses created every day.

What's more, you get all this ironclad



DETECTION, PREVENTION, DESTRUCTION. IF YOUR ANTI-VIRUS SOFTWARE DOESN'T HAVE ALL THREE, YOU'LL BE COMPLETELY EXPOSED TO VIRUSES IN WINDOWS 95.

can work in this new environment.

But which anti-virus product should you buy? Norton AntiVirus® for Windows 95.

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YOU CAN REST EASY.**

Norton AntiVirus for Windows 95 is certified by the National Computer Security Association. And recent independent tests* conclusively demonstrate that Norton AntiVirus for Windows 95 detects and destroys as many or



more known viruses as any other anti-virus product. But our virus protection doesn't stop there. The new Norton AntiVirus for Windows 95 also protects you from new, unknown viruses. Thanks to a unique virus detection technology that allows us to spot any suspicious activity, no matter where it's lurking.

So your system is safe. Not just

protection without a host of long annoying disruptions to your work.

Because Norton AntiVirus for Windows 95 scans files fast. Even compressed files.

And Norton AntiVirus works in the background, continuously monitoring file access and usage. So it can stop viruses in their tracks. Which means you don't have to



NORTON ANTIVIRUS FOR WINDOWS 95

WINDOWS 95 COMPLIANT
Full 32-bit application. Supports long file names and Universal Naming Conventions.

**AUTOMATIC
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Virtual device driver unobtrusively checks for viruses in the background. Ensures backups and files transferred are virus-free.

FAST SCANNING
Provides ironclad virus protection without affecting productivity. Scans even compressed files fast.

EXCLUSIVE VIRUS SENSOR
Provides continuous transparent protection against new, unknown viruses.



worry every time you put a floppy in your disk drive.

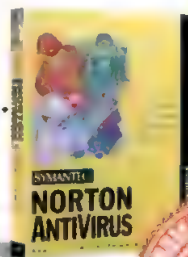
THE NO RISK ANTI-VIRUS SOLUTION.

Needless to say, Norton AntiVirus for Windows 95 comes with our standard sixty-day money-back guarantee.

So why gamble on running Windows 95 without all the virus protection you can get. Get your trade-up edition of Norton AntiVirus for Windows 95 today.

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- If you own Norton AntiVirus, Central Point Anti-Virus, Norton Desktop for Windows, or PC Tools, get your \$29.95 trade-up edition** of Norton AntiVirus for Windows 95 today.
- McAfee VirusScan and Dr. Solomon's Anti-Virus owners also eligible. To purchase, visit your software store or call us at 1-800-450-9760 ext. 9173.



SYMANTEC.

*Tests conducted by NCSA and Patricia M. Hoffman (VSUM), Aug. 1995. **Trade-up editions will run only when specified Symantec, Central Point, McAfee or Dr. Solomon's products are already installed. Check with your software store for qualifying versions. Price does not include shipping & handling or any applicable sales tax. Symantec and Norton AntiVirus are registered trademarks of Symantec Corp. All other brand names or trademarks are the property of their respective owners. ©1995 Symantec Corp. All rights reserved. Visit us on the Internet at <http://www.symantec.com>. In Canada, call 1-800-365-8641. In Australia, call 2-879-6577. In Europe, call 31-71-353111

CIRCLE 375 ON READER SERVICE CARD

Kbps data/fax modem.

The Saturn P100 mini-tower system used the same CD-ROM drive but came with a Maxtor 1GB hard disk, a Diamond Stealth64 DRAM graphics board with 2MB of DRAM, a Creative Labs Vibra 16S FM synthesis sound board, and a U.S. Robotics 14.4-Kbps fax modem. Both systems included a 15-inch monitor and QIC Model 9903 80-watt amplified speakers.

The Apollo P133, with its VRAM-based graphics adapter and 256K synchronous pipelined-burst cache, posted average scores on all tests. The Saturn

P100, which uses a DRAM-based graphics card and slower asynchronous SRAM, came up with mainly below-average scores but did manage average Winstone 96 and CD-ROM WinMark 96 test scores.

HiQ includes a one-year parts and two-year labor warranty. Two years of on-site service is \$92.95 for the Apollo P133 and \$79.95 for the Saturn P100.—RSA
HiQ Computer Systems, Sunnyvale, CA; 800-827-5836, 408-245-5836; fax, 408-245-3108.

Circle 490 on reader service card

IPC Technologies Inc.

Austin PowerPlus 133

For \$4,399, IPC Technologies' Austin PowerPlus 133 is a top-notch system with top-of-the-line components, including a 2GB hard disk and a sextuple-speed CD-ROM drive. This 133-MHz Pentium-based unit was a stellar performer on all of our Windows-based benchmark tests. IPC aims its PowerPlus desktops at both home and small-business users. The company sells PCs through its Austin Direct division.

The midsize tower unit came with a 2GB SCSI-2 hard disk and a sextuple-speed Plextor SCSI-2 CD-ROM drive, both hooked to an Adaptec AHA2940

IN SHORT
Here is a loaded, top-notch system with ample storage and great performance.

SERVICE & RELIABILITY
IPC Technologies Inc.

Reliability	Average
Repair	Average
Technical support	Average
Percent needing repair	Worse than average

PCI-based SCSI-2 controller. Sound capabilities were provided by the unit's integrated Creative Labs audio chip. Also aiding the unit's performance was its ATI Mach 64 PCI graphics card with 4MB of VRAM and its use of EDO DRAM and 256K of pipelined-burst L2 cache.

The PowerPlus 133 posted Winstone 96 and CD-ROM WinMark 96 scores that were among the very best in this roundup. Its Disk WinMark 96 and Graphics WinMark 96 scores were average for its class.

To facilitate setup, IPC includes a clear, illustrated system manual and one-sheet quick-setup guide with the system. A three-year warranty with one year of free on-site service is also included.—RSA

IPC Technologies Inc., Austin, TX; 800-752-1577, 512-339-3500; fax, 512-719-8180.

Circle 491 on reader service card

Initiative Technology Inc.

ITI 5133

Initiative Technology, a direct sale vendor, has tried to create a high-performance system for corporate power users. The company loaded its ITI 5133 mini-tower system with some top-notch components. As a result, the \$4,335 ITI 5133 juggles multimedia tasks with aplomb and most of its performance tests results were acceptable. Unfortunately, its Winstone 96 performance fails to impress.

ITI includes the requisite hardware in this system to support a 133-MHz Pentium processor. The unit uses a Micronics motherboard with EDO DRAM and 256K pipelined-burst L2 cache. A 1GB Western Digital hard disk, 17-inch monitor, and Practical Peripherals 28.8-/14.4-Kbps data fax modem are also included. Audio is managed by a Creative Labs Sound Blaster 16 card capable of FM synthesis.

On performance tests, the ITI 5133's SCSI-2 Plextor sextuple-speed CD-ROM drive proved effective, helping to earn the system one of the best CD-ROM WinMark 96 scores among the machines we



tested. The remainder of its test results were mixed. Its best score was an above-average Graphics WinMark 96 result, thanks to a Matrox Millennium graphics accelerator card with 2MB of VRAM. Its Disk WinMark 96 score was average for its class but its Winstone score was below average.

The ITI 5133 has two other weak spots that are worth noting. The unit's tiny Labtec CS-180 speakers deliver sound barely superior to the PC's internal speaker. Also, there is no wavetable-synthesis capability. For the price, better speakers and wavetable synthesis support should be standard.

The standard warranty is one-year parts and labor; on-site service is not included.—JRQ

Initiative Technology Inc., Brownwood, TX; 800-999-1413, 915-643-1845; fax, 915-643-4912.

Circle 492 on reader service card

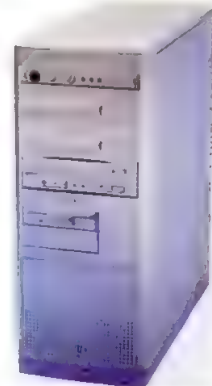
Maximus Computers

Magna ProMedia, Magna Graphics ProMedia

Maximus Computers' high-end \$3,695 Magna Graphics ProMedia is a 133-MHz Pentium tower system with lots to offer power users, while the \$2,695 Magna ProMedia gives new PC buyers reasonably priced 100-MHz Pentium performance. The company also offers a SCSI-based high-end desktop line.

Both machines use Triton-based motherboards with 256K of pipelined-burst L2 cache and EDO DRAM. Both also come with sextuple-speed CD-ROM drives. To keep costs down, the systems use DRAM-based Diamond Stealth64 Video graphics cards with S3's Vision868 chip (2MB VRAM cards are an additional \$100).

The Graphics ProMedia tower system comes with a 17-inch MAG monitor, a 28.8-/14.4-Kbps data/fax modem, and a



IN SHORT
A 17-inch monitor and 6X CD-ROM drive fail to mask mixed performance.

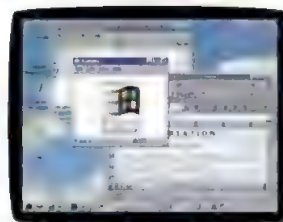
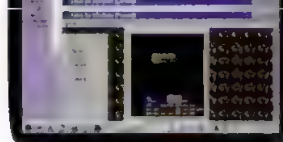
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Now try these ten easy exercises and see how you can work even better and faster in Windows 95 with the all-new Norton Navigator.[™]

CLICK. CLICK. CLICK. CLICK. **1.** First, copy a file from one directory to another. Okay, now copy another file. On average, it takes about eleven steps per file. Now copy a file with Norton Navigator.

5. Try a word search for "profits" or any other text string within files. It's at least ten times faster on average with Norton Navigator. No matter how many files you have. Or how big they are. In fact, the bigger the files, the more time you'll save.

6. Save another minute every time you delete, move, zip, or encrypt from



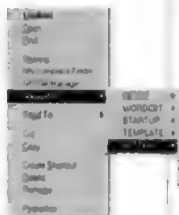
9. With Norton Navigator, you can create a different desktop for each project. So you can find your work more easily. And save even more time.

10. Windows 95 supports long file names for all of your new 32-bit applications. Norton Navigator supports long file names

THE TOP 10 REASONS WHY NORTON NAVIGATOR USERS WORK FASTER IN WINDOWS 95.

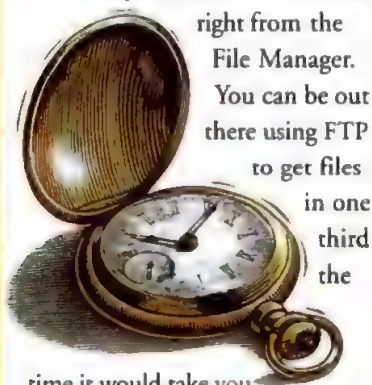
Mission accomplished. One step.

2. Opening a folder in Windows 95 takes a full five clicks of your trusty mouse. But with Norton Navigator, you can open any folder with just one simple click.



3. Compress a file. Our built-in PK-Zip compatible compression saves you a minute every time.

4. Use Norton Navigator to plug into your Internet connection right from the File Manager. You can be out there using FTP to get files



in one third the time it would take you with a separate application.

any application's Open or Save dialog box. (Are you keeping count?)

7. One click is all it takes to access recently opened files or folders from any application. Now isn't that better than wading through folders?

8. Launch your favorite files, folders, or applications simply by pushing a button on the Norton Taskbar. No more going up and down to and from the Start menu over and over again.

NORTON NAVIGATOR FOR WINDOWS 95

NORTON NAVIGATOR ACCELERATES YOUR FILE MANAGEMENT IN WINDOWS 95.

Norton Navigator puts file management at your fingertips with Norton File Manager, Explorer Extension and File Assist.

Norton Folder Navigator lets you open, copy, move or create a shortcut for any folder with just one mouse click.

Norton Taskbar features multiple desktops that let you organize your files and find your work faster.

Norton Find-It performs specific text string searches at least ten times faster than Windows 95.

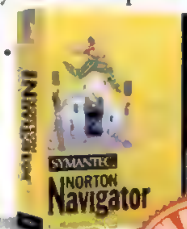


for most 16-bit applications, too. So you'll never again have to remember what "billgbox" means.

MAKE WINDOWS 95 AN EVEN BETTER PLACE TO BE.

Well, there you have it. Our Top Ten. But try Norton Navigator for yourself and we're sure you'll find your own favorites. Because one of the greatest things about Norton Navigator is it lets you work the way you want to work. Needless to say, it comes with our standard 60-day money-back guarantee. So get your trade-up edition today.

.....
 • If you own Norton
 • Desktop, PC Tools,
 • XTree, or Norton
 • Commander,
 • get your \$39.95
 • trade-up edition* of
 • Norton Navigator for Windows 95
 • today. To purchase, visit your
 • software store or call us at
 • 1-800-450-9760 ext. 9174.
 •



SYMANTEC.

SUMMARY OF FEATURES

Windows 95 Pentium PCs

Price of tested configuration For each machine, we quote the price for the entire system as tested by PC Labs, including the monitor and any other options installed by the vendor, such as modems, network cards, and any bundled software.

Processor Numeric suffixes to the Pentium name indicate clock speeds in megahertz.

Installed RAM Some machines use *EDO* (extended data out) DRAM, which can marginally boost performance over standard fast-page-mode DRAM.

Hard disk capacity and interface *EIDE* denotes Enhanced IDE, an extension to IDE that supports faster transfer rates, higher disk capacities, and mass-storage devices other than hard disks. *Fast ATA-2* denotes Seagate's EIDE-like specification for increased transfer rates and larger capacities.

Graphics adapter (and memory type) We list the graphics manufacturer and specify the memory type. VRAM and the new *WRAM* (Windows RAM—not associated with Microsoft Windows) graphics

memory types are faster than DRAM, because both can move data in and out simultaneously.

CD-ROM drive interface *ATAPI* is a specification that enables CD-ROM drives to act much like hard disks, which allows them to be connected to Enhanced IDE interfaces. *Proprietary* drives connect to a special connector on a sound board.

DOS, Windows version included *DOS* implies MS-DOS, unless otherwise specified. *WFWG* denotes Windows for Workgroups, and *Win* indicates Windows. *Dual boot* means the system offers you the option of using WFWG 3.11 or Windows 95.

Plug-and-play BIOS This can map out motherboard resources to ease upgrades when used with a plug-and-play-compliant operating system (such as Windows 95 or forthcoming versions of OS/2).

Expansion-bus slots *PCI cards* may share a backplate with ISA cards, meaning that you can use one or the other but not both simultaneously. These shared slots are listed as *PCI/ISA*.

equipped with Intel Triton chip sets, 256K of pipelined-burst L2 cache, and EDO DRAM. Each unit also came stocked with a Diamond Stealth64 Video VRAM graphics board with 2MB of VRAM and Creative Labs Vibra 16S sound card. Both PCs were set up with 1.5GB Western Digital IDE hard disks and quad-speed Toshiba CD-ROM drives.

The 590PCI16D was a solid performer in its CPU group. Its Disk WinMark 96 and Graphics WinMark 96 scores were above average, and its Winstone 96 and CD-ROM WinMark 96 scores were average.

The 5133PCI-16MT held its own on our benchmark tests. Scores on the Disk WinMark, Graphics WinMark, and Winstone tests

were average within the Pentium/133 processor group.

The 5133PCI16MT is housed in an easy-access midsize tower—no tools are needed. You just pull off the front panel, then the side panels slide off easily.

These units have a one-year parts and labor warranty. No on-site service is available.—RSA

Mega Computer Systems, San Diego, CA; 800-338-6628, 619-487-8888; fax, 619-485-1518.

Circle 494 on reader service card

Micro Express

MicroFlex-PCI/P100

The MicroFlex-PCI/P100, from Micro Express, is a solid 100-MHz Pentium performer, offered at the low price of \$2,149. The system's hard disk performance was particularly impressive for its processor class. Micro Express targets the unit we tested at corporate and demanding home users.

The MicroFlex PCI/P100 was the only PC in this roundup that included a graphics card—the STB Velocity 64V—with

Sound Blaster AWE32 audio card capable of wavetable synthesis. The package comes complete with Cakewalk composing software.

The Graphics ProMedia backs up the solid peripherals with good performance. On our Winstone 96 tests, its score was in the top five in its class. Other Windows-based test scores were average. In multimedia tests, the relatively slow access time of the MediaVision MV-600 CD-ROM drive lowered overall performance, but the drive's 6X throughput meant that all video clips played back as expected.

Compared with the 133-MHz Maximus system, the ProMedia comes with an FM-only audio card, a slower 14.4-Kbps fax modem, and a smaller 15-inch MAG monitor. Its test results mirrored its siblings', with above-average scores on our Winstone test and average scores on our other Windows-based tests. The unit also did very well against competitors on the CD-ROM multimedia tests.

The units have a one-year-parts, lifetime-labor warranty. Four years of on-site service are \$200.—JRQ

Maximus Computers, Monrovia, CA; 800-888-6294, 818-305-5925; fax 818-357-9140.

Circle 493 on reader service card

Mega Computer Systems

Impact 590PCI16D, Impact 5133PCI16MT

These two units from Mega Computer Systems were almost identically configured, but the \$2,700 Impact 590PCI16D is the better bargain. Its performance within the 90-MHz class was better than that of its high-end sibling, the \$3,150 Impact 5133PCI16MT, in the 133-MHz group. Both PCs target heavy-duty home or corporate users.

Both systems have Tyan motherboards



IN SHORT

Both units perform well, but the Impact 590PCI16D stands out in its class.

The ultimate fax solution for serious fax users!



Introducing the SatisFAXtion Modem plus WinFax PRO high value package!

On Speeding!

It just doesn't get any better... or faster. The SatisFAXtion 400 Modem. PC Computer Magazine rates it an average 65% faster than the next fastest modem tested. And, independent tests prove you can achieve an average savings of \$400 a year over other leading fax modems if you send 100 fax pages a month long distance. That's serious savings!

Serious Software!

What's the next best thing to a modem that has its own built-in microprocessor and memory to allow faxes to come and go in the background? You've got it...the world's most award winning software — Delrina's WinFax PRO 4.0. This is Delrina's full-function software package (not the "Lite" version) designed to deliver serious world class performance.

Get it Together & Save!

Now get the best of both worlds together and enjoy serious savings! Get Delrina's WinFax PRO 4.0 with your SatisFAXtion Modem at one low package price. Save every time you use your SatisFAXtion modem and save when you buy it together with WinFax PRO 4.0. Get the ultimate fax solution and start saving fast!

PUREDATA

1-800-661-8210

CIRCLE 301 ON READER SERVICE CARD



THIS IS BIG.

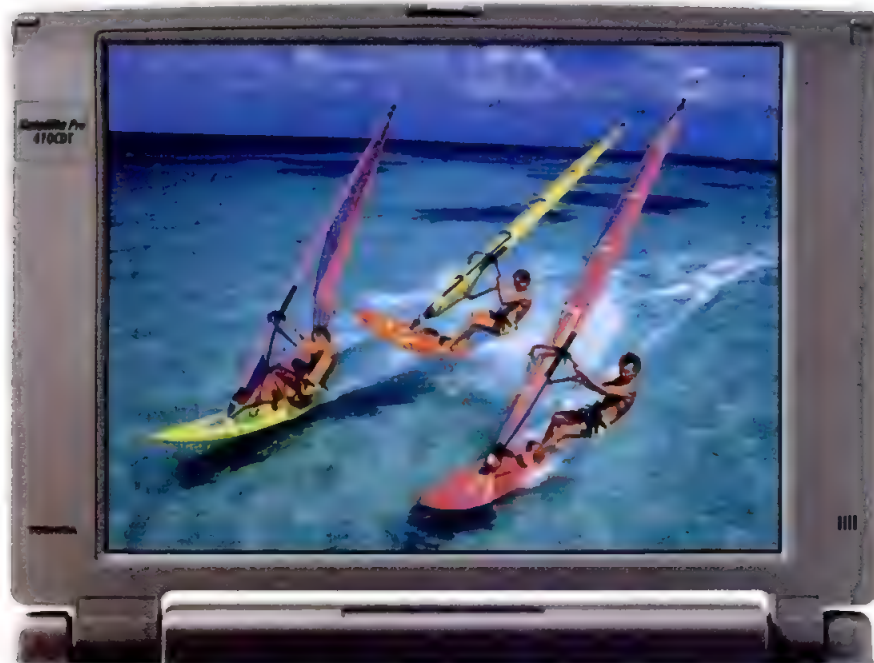


90MHz The Satellite Pro™ features the incredibly fast 2.9v, 90MHz Pentium™ processor, specifically designed for notebooks. It's all the speed you need for tasks such as database retrieval and multimedia presentations.

CD-ROM The 410CDT comes with a modular Quad-Speed CD-ROM drive, that can be easily swapped out with a floppy drive. Or hot-plug in the floppy drive externally and use both. You get the power of multimedia to go.

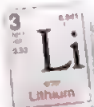
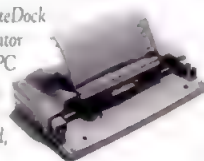


11.3" DIA. It's not just the size of this display that's awe-inspiring, it's the resolution. At 800x600, you see up to 56% more of your document than a standard screen*. So you see more columns in your spreadsheet or words in your document. In fact, you see more of everything.



NOTEDOCK™ ENHANCED PORT REPLICATOR

Toshiba's optional NoteDock Enhanced Port Replicator provides two Type III PC Card slots, and allows one-step connection to your monitor, keyboard, mouse and printer.



LITHIUM ION BATTERY

Toshiba's longlife Lithium Ion battery provides hours of power while you're on the road.

INTEGRATED AC ADAPTER

Engineered for ultimate portability, there's no bulky external AC adapter to carry. This slim power cord is all you need.



Satellite Pro™

410CDT:

- 11.3" dia. color TFT active matrix display supporting 64K simultaneous colors at 800x600 resolution
- Integrated modular Quad-Speed CD-ROM
- Modular 3.5" FDD included

410CS**:

- 11.3" dia. color DSTN dual-scan display supporting 256 simultaneous colors at 800x600 resolution

- Integrated modular 3.5" FDD
- Optional modular Quad-Speed CD-ROM
- BOTH MODELS:**
 - 90MHz Pentium™ processor (2.9v)
 - 810 Million Bytes (~772MB) HDD
 - 8MB EDO RAM expandable to 40MB
 - Lithium Ion battery
 - Sound Blaster™ Pro compatible, .WAV and MIDI sound support
 - Two stacked PC Card (PCMCIA) slots (two Type II or one Type III)
 - Infrared data port (IrDA-compliant)

- Plug and Play connectivity
- Built-in AC adapter
- AccuPoint™ integrated pointing device
- Optional NoteDock™ Enhanced Port Replicator
- Pre-installed software: Windows® 95 or MS-DOS® with Windows® for Workgroups, Run Time Video for Windows®, Indeo™ Video Interactive, and additional multimedia software

- Toll-free Technical Support — 7 days a week, 24 hours a day

Designed for

Microsoft®
Windows® 95


pentium

THIS ISN'T.

\$3499[†]
 Satellite Pro 410CS



INTRODUCING THE NEW SATELLITE PRO SERIES. The Satellite Pro™ offers super-fast 90MHz Pentium® performance with modular Quad-Speed CD-ROM. Pull up masses of information from large databases and develop sophisticated multimedia presentations. For real drama, a giant 11.3" display provides a stunning show of realistic images and color. And the sound is exceptional, with its crisp, clear stereo capabilities. You also get two stacked PC Card (PCMCIA) slots for maximum expandability, a staggering 810 million byte hard drive, and the ease of Plug and Play connectivity. The Satellite Pro offers the best of multimedia and portability in living color. But when you check the price, you won't believe your eyes. Call 1-800-457-7777 for more information or a dealer near you.

In Touch with Tomorrow
TOSHIBA

Toshiba. The World's Best Selling Portable Computers.

All prices, specifications and availability are subject to change. **Standard 640x480 resolution screen. **The 410CS is sold at selected resellers as the 415CS with Windows® 95 and additional pre-installed software
[†]Price for 410CS with the modular FDD only. A Quad-Speed CD-ROM is available as an optional upgrade. ©1995 Toshiba America Information Systems, Inc. All products indicated by trademark symbols are trademarked and/or registered by their respective companies. Intel Inside and Pentium Processor Logos are trademarks of Intel Corporation.

CIRCLE 379 ON READER SERVICE CARD

SUMMARY OF FEATURES

Windows 95 Pentium PCs

■ YES □ NO

Products listed in alphabetical order by company

	Aberdeen P133-PCI	ACMA z-Power100	ACMA z-Power133	All Computer Warehouse ACW Pentium P5-133B	AMAX P100 Powerstation	AMAX P133 Powerstation	AT&T Globalyst 630	Compaq ProLinea 5120
Street price (tested configuration)	\$3,395	\$3,295	\$3,595	\$2,604	\$3,005	\$3,844	\$3,250	\$3,524
Processor	Pentium/133	Pentium/100	Pentium/133	Pentium/133	Pentium/100	Pentium/133	Pentium/100	Pentium/120
Installed RAM	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB	16MB
Hard disk capacity and interface	1.5GB EIDE	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1.2GB EIDE	1.2GB EIDE	1.5GB EIDE	1GB EIDE
Graphics adapter	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Integrated S3 Trio 64	Integrated Cirrus Logic GD5434
Memory on graphics adapter	2MB VRAM	4MB VRAM	4MB VRAM	2MB VRAM	4MB VRAM	4MB VRAM	2MB DRAM	1MB DRAM
Monitor (and diagonal screen size)	Tatung CM17MLP (17")	MAG InnoVision DX17F (17")	MAG InnoVision DX17F (17")	Proton GM-1563 (15")	MAG InnoVision DX15Fe (15")	MAG InnoVision MXP17F (17")	AT&T 7156 (15")	Compaq 151FS (15")
CD-ROM drive	Toshiba XM-5302B	NEC CDR-512	NEC CDR-512	Toshiba XM-5302B	NEC CDR-512	NEC CDR-512	Matsushita CR-574-B	Sony CDU76E
Drive speed and interface	4x ATAPI	6x SCSI-2	6x SCSI-2	4x ATAPI	6x SCSI-2	6x SCSI-2	4x ATAPI	4x ATAPI
Sound adapter	Creative Labs Sound Blaster AWE32	Creative Labs Vibra 16	Creative Labs Vibra 16	Creative Labs CT2800	Creative Labs Vibra 16	Creative Labs Vibra 16	Creative Labs Vibra 16	None
Sound adapter interface	ISA card	Motherboard	Motherboard	ISA card	Motherboard	Motherboard	ISA card	N/A
Speakers/network adapter/modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95
Motherboard Components								
Installed external RAM cache and type	512K pipelined burst	256K pipelined burst	256K pipelined burst	512K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst
Motherboard manufacturer	Super Micro	Intel	Intel	ASUSTek	Intel	Intel	AT&T	Compaq
Chip set manufacturer and model	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	VLSI VL82C59x	Compaq
BIOS manufacturer and version (or date)	AMI (10/10/94)	AMI (5/17/95)	AMI (5/17/95)	Award (5/12/95)	AMI (5/17/95)	AMI (5/17/95)	Phoenix (8/3/95)	Compaq (7/26/95)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	128MB	128MB	128MB	128MB	128MB	128MB	192MB	192MB
Expansion bus slots	4 ISA, 4 PCI	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	5 ISA, 3 PCI	2 ISA, 2 PCI/ISA, 1 proprietary
Accessible drive bays (5.25", 3.5")	3, 2	3, 2	6, 1	5, 1	5, 2	5, 2	3, 1	2, 1
Internal drive bays (5.25", 3.5")	0, 2	0, 2	0, 1	0, 3	1, 1	1, 1	0, 2	0, 1
Power-supply wattage	250W	250W	250W	230W	250W	250W	250W	145W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 1, 1
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	2 years/lifetime	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years
On-site service charge	\$229.95 (4 years)	Included (1 year)	Included (1 year)	\$109.95 (1 year)	\$49 (1 year)	\$49 (1 year)	Included (1 year)	Included (1 year)

N/A—Not applicable: The product does not have this feature.

2MB of EDO VRAM. This card helped the system post an average Graphics WinMark 96 score. The unit fared well with its 1GB Quantum Fireball IDE hard disk, earning an above-average Disk WinMark 96 score. Helped by its disk results, the unit posted an above-average Winstone 96 score. Its CD-ROM WinMark 96 score was average.

IN SHORT

With a low price and impressive performance, this PC is worth a close look.

This midsize tower system came equipped with a Sony quad-speed CD-ROM drive, an OPTi 16-bit

FM-synthesis sound board, and a 15-inch monitor.

MicroFlex PCs come with a two-year warranty. On-site service is \$50 for the first year; tech support is available 24 hours, 7 days.—**RSA Micro Express**, Santa Ana, CA; 800-989-9900, 714-852-1400; fax, 714-852-1225.



Circle 495 on reader service card

Micron Electronics Inc. P100 Millennium, P133 Millennium Plus

The \$4,345 P133 Millennium Plus and \$3,346 P100 Millennium tower PCs, from Micron Electronics, justify their prices with reasonable performance and quality components. The 133-MHz model is geared to corporations; the 100-MHz unit is aimed at business and home-office users.

Micron is a major mail-order vendor with the unique advantage of having a parent company (Micron Technology) that manufactures memory. Micron also

						PC MAGAZINE EDITOR'S CHOICE		PC MAGAZINE EDITOR'S CHOICE					
Compaq Deskpro 5100	Compaq Deskpro XL 5133	Comtrade Multimedia MPEG Dream Machine	DataStor PS-100	DataStor PS-133	Dell Dimension P100c	Dell Dimension XPS P133c	Dell OptiPlex GM+ 5100	DFI Landmark P133VPM	Diamond Office Star DT100				
\$3,542	\$5,267	\$3,095	\$3,495	\$3,795	\$2,378	\$3,698	\$3,092	\$3,999	\$2,285				
Pentium/100	Pentium/133	Pentium/133	Pentium/100	Pentium/133	Pentium/100	Pentium/133	Pentium/100	Pentium/133	Pentium/100				
16MB	16MB	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB	16MB				
1GB EIDE	2GB SCSI-2	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1.5GB EIDE	1GB EIDE	1.2GB EIDE	1GB Fast ATA-2				
Compaq QVision 1280/P	Matrox Impression	Diamond Stealth 64 Video VRAM	Number Nine Imagine 128	Number Nine Imagine 128	Integrated S3 Triob4	Number Nine Imagine 128	Integrated S3 Triob4	DFI WG-3120P	Diamond Stealth 64 DRAM				
1MB VRAM	4MB VRAM	2MB VRAM	4MB VRAM	4MB VRAM	2MB DRAM	4MB VRAM	2MB DRAM	2MB DRAM	1MB DRAM				
Compaq 151FS (15")	Compaq QVision 172 (17")	KFC CA1507 (15")	ViewSonic 15GS (15")	ViewSonic 15GS (15")	Dell UltraScan 15TE (15")	Dell UltraScan 17XE (17")	Dell UltraScan 15TE (15")	ADI MicroScan 5EP (17")	Impression DCM-1588VA (15")				
Sony CDU78E	Sanyo CRD-254	Mitsumi CRMC-FX400	Mitsumi CRMC-FX400	Mitsumi CRMC-FX400	Mitsumi CRMC-FX400	TEAC CD-56E	NEC CDR-272	Sanyo CRD-254P	Mitsumi CRMC-FX400				
4x ATAPI	4x SCSI-2	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	6x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI				
None	Analog Devices SoundPort	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster AWE32	Creative Labs Sound Blaster AWE32	Creative Labs CT2260	Creative Labs CT2260	Creative Labs CT2260	Creative Labs Sound Blaster Pro	Media Sound MAD16				
N/A	Motherboard	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card				
  	  	  	  	  	  	  	  	  	  				
7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95				
256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K asynchronous	256K asynchronous	256K pipelined burst				
Compaq	Compaq	Super Micro	Elitegroup	Elitegroup	Intel	Intel	Dell	DFI	ASUSTek				
Compaq	Compaq	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	VLSI VL82C594x	Intel Triton				
Compaq (7/26/95)	Compaq (6/19/95)	AMI (10/10/94)	Phoenix (7/27/95)	Phoenix (7/27/95)	AMI (6/29/95)	AMI (7/27/95)	Phoenix/Dell (7/3/95)	Award (7/7/95)	Award (5/12/95)				
 	 	 	 	 	 	 	 	 	 				
													
192MB	144MB	128MB	128MB	128MB	128MB	128MB	128MB	512MB	128MB				
3 ISA, 1 PCI, 1 PCI/ISA	3 ISA, 1 PCI, 1 PCI/ISA	4 ISA, 4 PCI	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA				
3, 1	3, 0	3, 2	3, 2	3, 2	3, 1	3, 1	3, 1	6, 1	2, 2				
0, 1	0, 1	0, 3	0, 2	0, 2	0, 2	0, 2	0, 2	0, 3	0, 1				
185W	244W	210W	230W	230W	230W	145W	230W	250W	200W				
1, 1, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0				
 	 	 	 	 	 	 	 	 	 				
													
3 years/3 years Included (1 year)	3 years/3 years Included (1 year)	1 year/1 year \$25 (1 year)	3 years/3 years \$50 (1 year)	3 years/3 years \$50 (1 year)	3 years/1 year Included (1 year)	3 years/1 year Included (1 year)	3 years/1 year Included (1 year)	2 years/lifetime \$58 (1 year)	1 year/1 year Included (1 year)				

MAYBE YOU DON'T
NEED MORE PEOPLE.

MAYBE YOU DON'T
NEED MORE TIME.

MAYBE YOU JUST
NEED MORE MEMORY.



For more information call us at

(8 0 0) 3 3 7 - 3 8 0 6

or look for us on the Net:

<http://www.kingston.com>



These days, you can sum up the human condition like this: too much work, not enough time. Computers, of course, are supposed to ease the burden. But now, with all the new memory-hungry software out there, many computer systems aren't up to the task. Fortunately, there's a simple solution: add more memory. Recently, an independent study* revealed that by adding just four megabytes of memory, the average manager became 26% more productive. The average number cruncher improved by 12%.

So, why Kingston memory? Because Kingston makes memory for almost every PC, server, printer, and workstation known to man. Our memory is designed to meet, or even exceed, the specifications set by leading computer manufacturers. We test every cell on every chip on every module. (On a 16 megabyte module, that's 128 million cells.) If you ever need help, our service and support will quickly shoulder the load. Is it any wonder Fortune 1000 companies use Kingston memory more than any other brand?

Kingston
TECHNOLOGY CORPORATION

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PC MAGAZINE CIRCLE 106 ON READER SERVICE CARD

SUMMARY OF FEATURES

Windows 95 Pentium PCs

■ YES □ NO

Products listed in alphabetical order by company

	Diamond Office Master DT133	Digital Celebris GL 5100et	Digital Celebris XL 5133	DirectWave Blue Thunder P75P100B	DirectWave Blue Thunder P75P133B	DTK QUIN-54M/P100	DTK QUIN-54M/P133	Empac Saber P54-100
Street price (tested configuration)	\$2,735	\$3,278	\$5,049	\$2,445	\$3,449	\$2,990	\$3,700	\$2,995
Processor	Pentium/133	Pentium/100	Pentium/133	Pentium/100	Pentium/133	Pentium/100	Pentium/133	Pentium/100
Installed RAM	16MB	16MB EDO	16MB	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB
Hard disk capacity and interface	1GB Fast ATA-2	1.5GB EIDE	1GB SCSI-2	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1.2GB EIDE
Graphics adapter	Diamond Stealth 64 DRAM	Integrated Matrox 2064W	Matrox MGA Millennium	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM
Memory on graphics adapter	2MB DRAM	2MB VRAM	2MB VRAM	2MB VRAM	2MB VRAM	2MB VRAM	2MB VRAM	2MB VRAM
Monitor (and diagonal screen size)	Impression DCM-1588VA (15")	Digital PCXBV-PC (15")	Digital PCXBV-PC (15")	MAG InnoVision DX15Fe (15")	MAG InnoVision DX17F (17")	Tatung TD-15NLGS (15")	ADI MicroScan SEP (17")	Optquest 2000DC (15")
CD-ROM drive	Mitsumi CRMC-FX400	Mitsumi CRMC-FX400	Toshiba XM-5201B	Mitsumi CRMC-FX400	Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302B	Creative Labs GCD-R540B
Drive speed and interface	4x ATAPI	4x ATAPI	4x SCSI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI
Sound adapter	Media Sound MAD16	ESS Audio Drive	Media Vision Jazz 16	Creative Labs CT2800	Creative Labs Sound Blaster AWE32	Creative Labs CT2800	Creative Labs CT2800	Creative Labs Sound Blaster 16
Sound adapter interface	ISA card	Motherboard	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card
Speakers/network adapter/modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95
Motherboard Components								
Installed external RAM cache and type	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst	512K asynchronous	512K asynchronous	256K asynchronous
Motherboard manufacturer	ASUSTek	Digital	Digital	ASUSTek	ASUSTek	DTK	DTK	Acer
Chip set manufacturer and model	Intel Triton	Intel Triton	Intel Neptune	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton
BIOS manufacturer and version (or date)	Award (5/12/95)	Phoenix (7/25/95)	Phoenix (7/20/95)	Award (6/28/95)	Award (6/28/95)	Award (8/9/95)	Award (8/9/95)	AMI (10/10/94)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	128MB	128MB	192MB	128MB	128MB	256MB	128MB	128MB
Expansion bus slots	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 1 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	3, 2	3, 1	3, 1	3, 2	3, 2	4, 1	4, 1	6, 1
Internal drive bays (5.25", 3.5")	0, 2	0, 3	0, 1	0, 2	0, 2	0, 4	0, 4	0, 3
Power-supply wattage	200W	200W	300W	200W	200W	250W	250W	250W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 1, 0	1, 2, 0	1, 2, 0
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	1 year/1 year	3 years/3 years	3 years/3 years	1 year/lifetime	1 year/lifetime	2 years/2 years	2 years/2 years	2 years/1 year
On-site service charge	Included (1 year)	Included (1 year)	Included (1 year)	\$45 (1 year)	\$45 (1 year)	\$50 (1 year)	\$50 (1 year)	\$125 (1 year)

MidWest Micro

MidWest Micro P5-100 Office PC, MidWest Micro P5-120 Office PC

The two MidWest Micro systems are attractively priced and offer good components and software, but the high-end 120-MHz system is more of a bargain. The \$3,499 MidWest Micro P5-120 Office PC had solidly average test scores for its class and offers a 17-inch monitor. Its 100-MHz sibling, the \$2,799

MidWest Micro P5-100 Office PC, was a helped it achieve an average score on our below-average graphics performer and turned in a Winstone 96 score that was barely average. MidWest Micro targets the small-office/home-office market with its PCs, and also has a Home PC line for the family market.

Both units feature Intel motherboards with Triton chip sets, EDO DRAM, and 256K asynchronous L2 caches. The P5-100 has a Quantum Fireball 1GB hard disk, which

IN SHORT
The Office PC line combines good prices and performance.

SERVICE & RELIABILITY MidWest Micro

Reliability	Better than average
Repair	Average
Technical support	Average
Percent needing repair	Average

Disk WinMark 96 tests. The system did not do as well with its ATI mach64-based WinBoost graphics card with 2MB of slower DRAM: It had a below-average Graphics WinMark 96 score. The unit's Winstone score was barely average.

The P5-120, which came with a 1.5GB hard disk, had the best Winstone and Disk WinMark scores in its class. Using a faster ATI WinTurbo graphics card with 2MB of VRAM, it turned

EPS Pinnacle P90	EPS Pinnacle P133	Ergo ThunderBrick 100	Ergo ThunderBrick 133	Gateway P5-100	Gateway P5-133 Best Buy	GST Aspegree 133	Hertz P90e	Hertz P133e	HiQ Saturn P100
\$2,699	\$3,399	\$3,195	\$3,495	\$3,267	\$3,758	\$2,489	\$2,295	\$4,250	\$2,349
Pentium/90	Pentium/133	Pentium/100	Pentium/133	Pentium/100	Pentium/133	Pentium/133	Pentium/90	Pentium/133	Pentium/100
16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB	16MB EDO	16MB
1GB EIDE	1GB EIDE	1.2GB EIDE	1.2GB EIDE	1GB EIDE	1.5GB EIDE	1GB Fast ATA-2	1GB EIDE	2GB SCSI-2	1GB EIDE
Number Nine Motion 771	Number Nine Motion 771	ATI Graphics Xpression	ATI Graphics Pro Turbo	Matrox MGA Millennium	Matrox MGA Millennium	Diamond Stealth 64 Video VRAM	ASUSTek PCI-AV264CT	ATI Graphics Pro Turbo	Diamond Stealth 64 DRAM
2MB VRAM	4MB VRAM	2MB DRAM	2MB VRAM	2MB WRAM	2MB VRAM	2MB VRAM	1MB DRAM	4MB VRAM	2MB DRAM
CTX 1765GMe (17")	CTX 1785GMe (17")	Nokia 447L (17")	Nokia 447L (17")	Sony Vivitron 1776 (17")	Sony Vivitron 1776 (17")	Aurora Vision SM583 (15")	Princeton Ultra 15 (15")	Princeton Ultra 17 (17")	Hitachi SuperScan Pro 15 (15")
Mitsumi CRMC-FX400	Mitsumi CRMC-FX400	Toshiba XM-5302TA	Toshiba XM-5302TA	Mitsumi CRMC-FX400	Mitsumi CRMC-FX400	Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302TA	Toshiba XM-5302TA
4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI
Turtle Beach Monte Carlo	Turtle Beach Monte Carlo	Creative Labs Vibra 16	Creative Labs Vibra 16	Creative Labs Vibra 16	Creative Labs Vibra 16	Creative Labs Vibra 16	ASUSTek PCI-AV264CT	Creative Labs Sound Blaster 16 Value	Creative Labs Vibra 16
ISA card	ISA card	Motherboard	Motherboard	ISA card	ISA card	Motherboard	Proprietary	ISA card	ISA card
■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95
256K asynchronous FIC	256K asynchronous FIC	256K pipelined burst Intel	256K pipelined burst Intel	None Intel	256K pipelined burst Intel	512K pipelined burst Intel	256K asynchronous ASUSTek	512K pipelined burst ASUSTek	256K asynchronous HiQ
Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton
Award (4/18/95)	Award (7/3/95)	AMI (5/10/95)	AMI (5/10/95)	AMI (3/6/95)	AMI (3/6/95)	AMI (5/17/95)	Award (7/20/95)	Award (7/20/95)	AMI (5/5/95)
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB
3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 1 Local Bus, 3 PCI, 1 PCI/ISA	3 ISA, 1 Local Bus, 3 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA
3.2	3.2	3.2	3.2	3.1	4.1	4.0	3.2	4.1	3.2
0.2	0.2	0.2	0.2	0.3	0.4	2.2	0.2	0.3	1.2
200W	200W	200W	200W	145W	145W	250W	200W	250W	250W
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
3 years/3 years Included (1 year)	3 years/3 years Included (1 year)	4 years/4 years Included (4 years)	4 years/4 years Included (4 years)	3 years/1 year Included (1 year)	3 years/1 year Included (1 year)	1 year/1 year \$94 (3 years)	1 year/1 year \$495 (1 year)	1 year/1 year \$495 (1 year)	1 year/2 years \$79.95 (2 years)

in an average Graphics WinMark score.

While a few video-clip frame drops were reported in our multimedia testing on both MidWest Micro PCs, they weren't noticeable. Each model came with a set of Altec Lansing ACS5 speakers and a Multimedia WaveRider 32+ sound card. Also included was Microsoft Office Professional. MidWest Micro backs

the units with a three-year warranty.—**BB MidWest Micro, Fletcher, OH; 800-871-9127, 513-368-2309; fax, 800-562-6622.**

Circle 496 on reader service card

MiTAC Corp.

Performance Series 90, Performance Series 120

The \$3,950 Performance Series 120 and \$3,175 Performance Series 90 desktops, from MiTAC Corp.'s 586P-95 line, are adequate machines with good software bundles. Both units performed reasonably well on all of our

benchmark tests. Both systems are aimed at home and small-business users as well as at corporate users. MiTAC also manufactures a line of units for resellers.

The two machines we reviewed used the same desktop case and had similar configurations. Both came with a 1GB Seagate IDE hard disk, a Sony quad-speed CD-ROM drive, and an FM-synthesis-capable MediaVision Jazz 16 sound board. Each unit also had 256K of asynchronous cache.

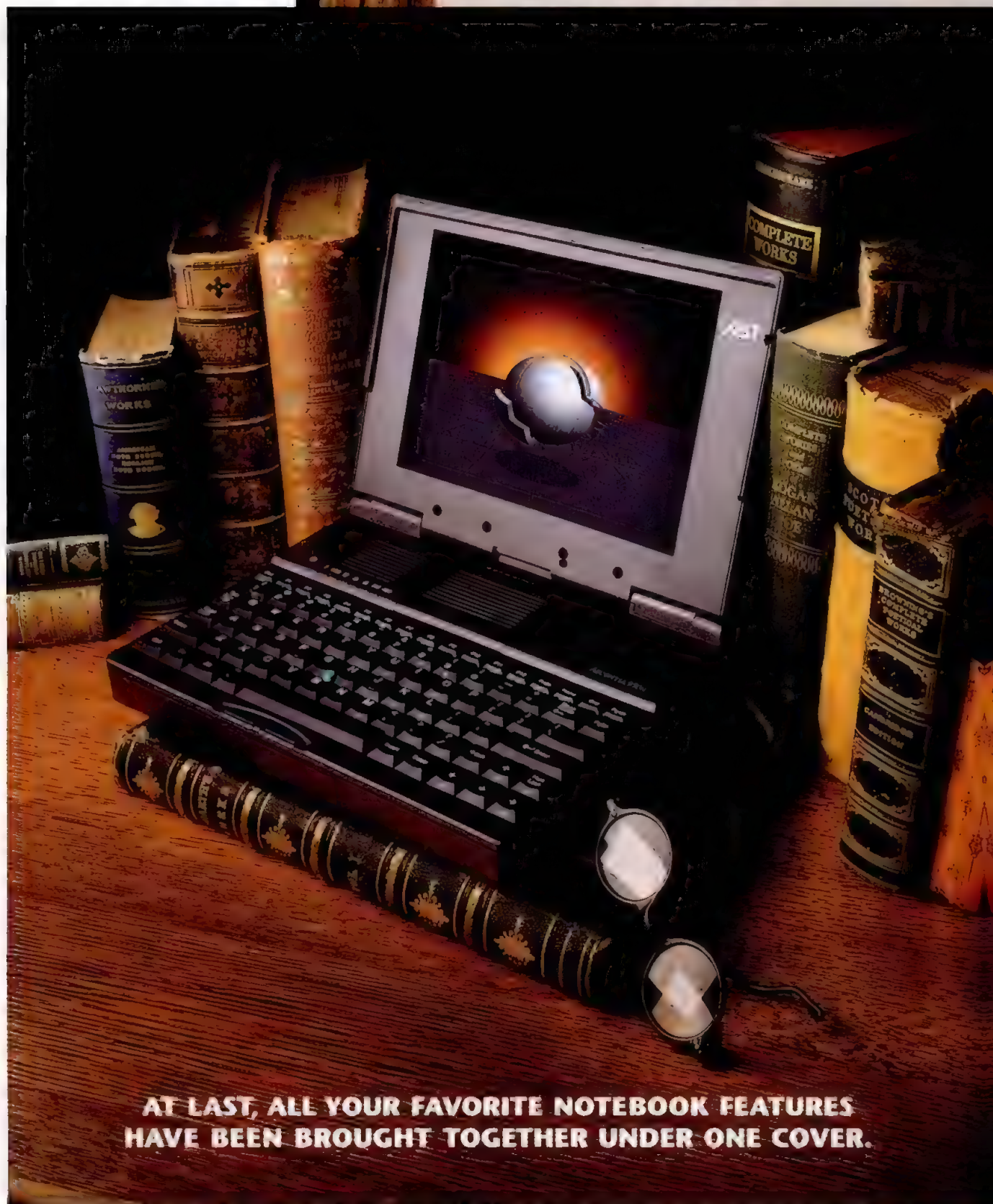
IN SHORT

The Performance units: solid performers with good software bundles.



You've seen performance notebooks with this feature...
Or that feature. But everything? Well, complete only begins
to describe the Ascentia™ 950N.

First, there's the 120 MHz Intel® Pentium processor. It's all



**AT LAST, ALL YOUR FAVORITE NOTEBOOK FEATURES
HAVE BEEN BROUGHT TOGETHER UNDER ONE COVER.**

the power you need to run the most demanding software. Some notebooks are great for memos. This one is capable of something more on the scale of *War and Peace*.

There's also a huge 11.8" Super VGA 800 x 600 resolution

screen, in active-matrix TFT. You'll see 56% more of your document, which cuts down on panning and scrolling. In other words, you'll get the complete picture.

Your projects will sound better, too, with 16-bit Sound Blaster® features and an embedded speaker and microphone. So you can easily take a track off that new CD and drop in a video clip for impressive multimedia presentations.

And since we wouldn't want to interrupt the flow of the next great American novel or the quarterly sales report, there's a long-lasting Lithium Ion battery. Infrared technology for wireless printing and transferring of files? Got that, too.

Even the 3-year worldwide warranty* comes with round-the-clock telephone support and our ExeCare™ 48-hour rapid repair service.**



THE COMPLETE PENTIUM NOTEBOOK

Processor:
120, 90 or 75 MHz Pentium,
256 KB Level 2 Cache

RAM:
8 MB expandable
to 40 MB

Screen:
11.8" (Diagonal)
Super VGA 800 x 600
TFT or 10.4" (Diagonal)
VGA TFT

Multimedia:
Sound Blaster 16-bit
sound system

Hard Drives:
500 MB, 800 MB
or 1.2 GB

Battery:
Lithium Ion, for up
to 6 hours

Weight:
6.2 pounds

For more information on the Ascentia 950N's abundant features and a reseller near you, call 800-876-4AST. We can even fax back the information. Yes, we've thought of everything.

AST
COMPUTER

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CIRCLE 122 ON READER SERVICE CARD

SUMMARY OF FEATURES

Windows 95 Pentium PCs

	HiQ Apollo P133	IPC Austin PowerPlus 133	Initiative ITI 5133	Maximus Magna ProMedia	Maximus Magna Graphics ProMedia	Mega Impact 590PC116D	Mega Impact 5133PC116MT	Micro Express MicroFlex-PC/P100
Products listed in alphabetical order by company								
Street price (tested configuration)	\$3,260	\$4,399	\$4,335	\$2,695	\$3,695	\$2,700	\$3,150	\$2,149
Processor	Pentium/133	Pentium/133	Pentium/133	Pentium/100	Pentium/133	Pentium/90	Pentium/133	Pentium/100
Installed RAM	16MB	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB EDO
Hard disk capacity and interface	1.5GB EIDE	2GB SCSI-2	1GB EIDE	1.2GB EIDE	1.5GB EIDE	1.5GB EIDE	1.5GB EIDE	1GB Fast ATA-2
Graphics adapter	Diamond Stealth 64 Video VRAM	ATI Graphics Pro Turbo	Matrox MGA Millennium	Diamond Stealth 64 DRAM	Diamond Stealth Video	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	STB Velocity 64 Video
Memory on graphics adapter	2MB VRAM	4MB VRAM	2MB VRAM	2MB DRAM	2MB DRAM	2MB VRAM	2MB VRAM	2MB EDO VRAM
Monitor (and diagonal screen size)	Hitachi SuperScan Pro 15 (15")	KFC CA1501 (15")	Princeton Ultra 17 (17")	MAG InnoVision DX15Fe (15")	MAG InnoVision DX17F (17")	MGC DCM-1588E (15")	MGC DCM-1588E (15")	GVC M1566LR (15")
CD-ROM drive	Toshiba XM-5302TA	Plextor PX-63CS	Plextor PX-63CS	Media Vision MV-4x	Media Vision MV-4x	Toshiba XM-5302B	Toshiba XM-5302B	Sony CDU76E
Drive speed and interface	4x ATAPI	6x SCSI-2	6x SCSI-2	6x ATAPI	6x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI
Sound adapter	Creative Labs Vibra 16	Creative Labs Vibra 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster AWE32	Creative Labs CT2800	Creative Labs CT2800	OPTi Media Sound 16
Sound adapter interface	Motherboard	Motherboard	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card
Speakers/network adapter/modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95
Motherboard Components								
Installed external RAM cache and type	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K pipelined burst
Motherboard manufacturer	HiQ	Intel	Micronics	Super Micro	Super Micro	Tyan	Tyan	Tyan
Chip set manufacturer and model	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton
BIOS manufacturer and version (or date)	AMI (5/17/95)	AMI (5/10/95)	Phoenix (5/3/95)	AMI (10/10/94)	AMI (10/10/94)	Award (5/29/95)	Award (7/25/95)	Award (6/6/95)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB
Expansion bus slots	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI	4 ISA, 4 PCI	4 ISA, 4 PCI	4 ISA, 4 PCI	4 ISA, 4 PCI
Accessible drive bays (5.25", 3.5")	4, 0	3, 2	3, 2	3, 2	6, 2	3, 2	4, 1	3, 2
Internal drive bays (5.25", 3.5")	3, 0	0, 2	0, 2	0, 2	0, 3	0, 2	0, 4	0, 2
Power-supply wattage	250W	200W	300W	230W	230W	250W	250W	230W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 1, 0	1, 2, 0	1, 1, 0	1, 2, 0	1, 2, 0	1, 2, 0
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	1 year/2 years	3 years/3 years	1 year/1 year	1 year/lifetime	1 year/lifetime	1 year/1 year	1 year/1 year	2 years/2 years
On-site service charge	\$92.95 (2 years)	Included (1 year)	N/A	\$200 (4 years)	\$200 (4 years)	N/A	N/A	\$50 (1 year)

N/A—Not applicable: The product does not have this feature.

The Performance 120 had a decided edge in graphics over its less expensive sibling, however. It used a Diamond Stealth 64 Video VRAM graphics board with 2MB of VRAM while the Performance 90 came equipped with the slower Diamond Stealth 64 DRAM graphics

board with 2MB of DRAM.

The two systems were consistently solid performers, yielding average scores on all of our Windows-based tests for their respective classes.

The MiTAC units also came with some useful software, including Novell Perfect Office and CorelDraw 4. The PCs are backed with a one-year parts-and-labor warranty. On-site service is \$35 per year, and is available for the first three years you own your system.—RSA
MiTAC Corp., Fremont, CA; 800-756-9888; fax, 510-440-3599.

Circle 497 on reader service card

Mitsuba Corp.

**Executive P-100,
Executive P-133**

Mitsuba Corp. offers two network-ready PCs for corporate users: The \$3,999 Executive P-133 and the \$2,395 Executive P-100. Both machines offered some good hardware, including a fax modem, but neither performed well in its respective class. Mitsuba also offers the Pro-

IN SHORT

Both machines are network-ready, but neither was a stellar performer.



Micron P100 Millennia	Micron P133 Millennia Plus	MidWest Micro P5-100 Office PC	MidWest Micro P5-120 Office PC	MITAC 586P-95 Series Performance 90	MITAC 586P-95 Series Performance 120	Mitsuba Executive P-100	Mitsuba Executive P-133	Multiwave Ultra Power 133	NEC PowerMate V100
\$3,346	\$4,345	\$2,799	\$3,499	\$3,175	\$3,950	\$2,395	\$3,999	\$3,199	\$3,328
Pentium/100	Pentium/133	Pentium/100	Pentium/120	Pentium/90	Pentium/120	Pentium/100	Pentium/133	Pentium/133	Pentium/100
16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB	16MB	16MB EDO	16MB EDO	16MB EDO	16MB EDO
1.2GB EIDE	2GB Ultra SCSI	1GB EIDE	1.5GB EIDE	1GB Fast ATA-2	1GB Fast ATA-2	1.2GB EIDE	2GB SCSI-2	1.2GB EIDE	1GB Fast ATA-2
Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	ATI WinBoost	ATI Graphics Win Turbo	Diamond Stealth 64 DRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 DRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Integrated AP 6422
2MB VRAM	2MB VRAM	2MB DRAM	2MB VRAM	2MB DRAM	2MB VRAM	2MB DRAM	4MB VRAM	2MB VRAM	2MB DRAM
ADI 15FGx (15")	ADI 15FGx (15")	Infotel SRC1503L (15")	Infotel SRC1703L (17")	MITAC L1564Plus (15")	MITAC L1564Plus (15")	Mitsuba M15VS (15")	Mitsuba M15VS (15")	Acer AcerView 71761 (17")	NEC MultiSync XE15 (15")
TEAC CD 56E	Plextor PX-63CS	Acer 645A	Acer 645A	Sony CDU76E	Sony CDU76E	Toshiba XM-5302B	Toshiba XM-3601B	TEAC CD 56E	Mitsumi CRMC-FX400
6x ATAPI	6x SCSI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x SCSI-2	6x ATAPI	4x ATAPI
Creative Labs CT2800	Creative Labs Sound Blaster AWE32 Lite	Aztech 2316A	Aztech 2316A	Amstar Jazz 16	Amstar Jazz 16	Creative Labs Vibra 16	Creative Labs Sound Blaster 16 Value	Creative Labs Sound Blaster 16	OPTi 82C930A
ISA card	ISA card	ISA card	ISA card	ISA card	ISA card	Motherboard	ISA card	ISA card	Motherboard
7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95
256K pipelined burst	256K pipelined burst	256K asynchronous	256K asynchronous	256K asynchronous	256K asynchronous	256K asynchronous	256K asynchronous	256K pipelined burst	256K pipelined burst
Micronics	Micronics	Intel	Intel	MITAC	MITAC	Intel	Intel	Acer	NEC
Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton
Phoenix (5/3/95)	Phoenix (8/2/95)	AMI (5/5/95)	AMI (5/5/95)	Award (8/8/95)	Award (8/8/95)	AMI (5/17/95)	AMI (5/17/95)	Phoenix (6/20/95)	Phoenix (8/9/95)
128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB
3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 1 PCI, 1 PCI/ISA
3, 1	3, 1	3, 2	3, 2	2, 1	2, 1	3, 2	4, 1	3, 2	3, 1
0, 2	0, 2	1, 2	1, 2	0, 1	0, 1	0, 2	0, 4	0, 2	0, 1
200W	200W	230W	230W	200W	200W	200W	250W	250W	200W
1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1
1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	1 year/1 year	1 year/1 year	2 years/2 years	2 years/2 years	1 year/1 year	3 years/3 years
Included (1 year)	Included (1 year)	N/A	N/A	\$35 (1 year)	\$35 (1 year)	Included (2 years)	Included (2 years)	\$30 (1 year)	Included (1 year)

fessional line of 486-based PCs.

The P-133 system was designed for the networked corporate user. It came in a fat tower case which offered easy access to internal components. The system included a 2GB SCSI-2 hard disk, a 28.8-Kbps fax modem, an Intel EtherExpress Pro/100 PCI-based Ethernet card (handling 10-Mbps or 100-Mbps connections) and a Diamond Stealth64 Video VRAM graphics board with 4MB of VRAM. A Sound Blaster 16 card also came with the unit.

The P-100 is a more mainstream corporate PC, but it also comes ready for network use. It included a 1.2GB hard disk, a

14.4-Kbps fax modem, an Ethernet card, and a Diamond Stealth 64 DRAM PCI-based graphics card with 2MB of DRAM. Its 16-bit audio chip is integrated onto the motherboard.

Both Mitsuba machines were disappointing performers on some of our benchmark tests. The P-133 logged below-average scores on our Winstone 96 and Graphics WinMark 96 tests for its class. The unit did have an average Disk WinMark 96 score, though. Because of its budget-oriented Conner CFS 1275A

hard disk, the P-100 had one of the lowest Disk WinMark scores in its CPU class. It did, however, yield average Winstone and Graphics WinMark scores. Both PCs turned in average scores on our CD-ROM WinMark 96 tests.

The Mitsuba units are backed by a two-year warranty; on-site service is included for both years.—RSA

Mitsuba Corp., LaVerne, CA;
800-648-7822, 909-392-2000;
fax, 909-392-2021.

Circle 498 on reader service card



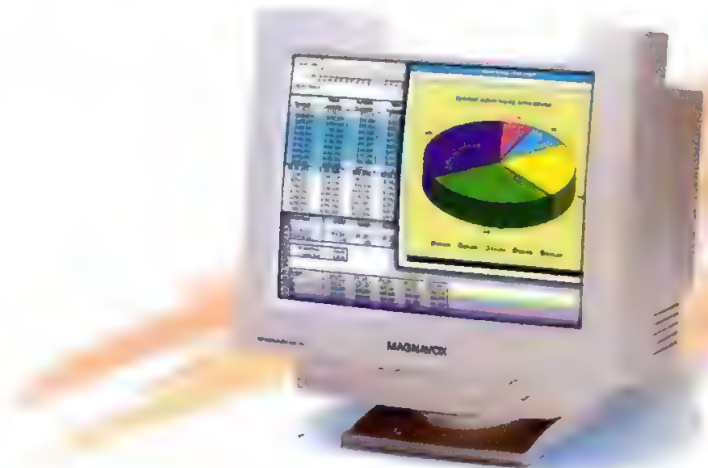
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CIRCLE 015 ON READER SERVICE CARD

SUMMARY OF FEATURES

Windows 95 Pentium PCs

■ YES ■ NO

Products listed in alphabetical order by company

	NEC PowerMate P133	NETIS Budget N5100P	PacTron DaytonaWin- 120NX	PerComp P100 Professional	PerComp P133 Professional	Polywell Poly 5100T3	Polywell Poly 5133T3	Premia Express Station P133
Street price (tested configuration)	\$3,778	\$2,195	\$2,750	\$3,199	\$3,999	\$2,555	\$2,995	\$2,599
Processor	Pentium/133	Pentium/100	Pentium/120	Pentium/100	Pentium/133	Pentium/100	Pentium/133	Pentium/133
Installed RAM	16MB EDO	16MB	16MB EDO	16MB EDO	16MB EDO	16MB	16MB	16MB EDO
Hard disk capacity and interface	1.5GB EIDE	1.5GB EIDE	1.2GB EIDE	1.2GB EIDE	1.2GB EIDE	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2
Graphics adapter	Integrated 53 Tric64V+	Diamond Stealth 64 DRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 DRAM	Diamond Stealth 64 Video VRAM	ATI Graphics Xpression
Memory on graphics adapter	2MB DRAM	2MB DRAM	4MB VRAM	2MB VRAM	4MB VRAM	2MB DRAM	2MB VRAM	2MB DRAM
Monitor (and diagonal screen size)	NEC MultiSync XE15 (15")	Sampo AlphaScan 15g (15")	Altus 1475 (14")	Percomp DA-1765VA F (17")	Percomp DA-1765VA F (17")	Sampo AlphaScan 15mx (15")	Sampo AlphaScan 15mx (15")	CompuTrend F562DU (15")
CD-ROM drive	NEC CDR-502	Acer C645	Mitsumi CRM-C-FX400	Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302B	Goldstar GCD-R540B
Drive speed and interface	6x SCSI-2	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x EIDE
Sound adapter	Creative Labs Vibra 16	US Sente SP300	Creative Labs CT2260	Logitech Soundman Wave	Logitech Soundman Wave	Creative Labs Sound Blaster 16 Value	Creative Labs Sound Blaster 16 Value	Creative Labs CT2260
Sound adapter interface	Motherboard	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card
Speakers/network adapter/modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95
Motherboard Components								
Installed external RAM cache and type	256K pipelined burst	256K asynchronous	256K pipelined burst	256K pipelined burst	256K pipelined burst	256K synchronous	256K synchronous	256K synchronous
Motherboard manufacturer	NEC	Intel	Super Micro	Super Micro	Super Micro	Tyan	Tyan	CompuTrend
Chip set manufacturer and model	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton
BIOS manufacturer and version (or date)	AMI (8/11/95)	AMI (5/5/95)	AMI (10/10/94)	AMI (10/10/94)	AMI (10/10/94)	Award (4/29/95)	Award (6/6/95)	Award (7/12/95)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB
Expansion bus slots	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 4 PCI	4 ISA, 4 PCI	4 ISA, 4 PCI	4 ISA, 4 PCI	4 ISA, 4 PCI	3 ISA, 3 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	3, 1	3, 2	3, 2	2, 2	3, 1	3, 2	3, 2	3, 2
Internal drive bays (5.25", 3.5")	0, 2	0, 2	0, 2	0, 1	0, 2	0, 2	0, 2	0, 1
Power-supply wattage	201W	230W	200W	230W	230W	230W	230W	200W
Parallel, serial, mouse ports	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	3 years/3 years	1 year/2 years	2 years/2 years	1 year/1 year	1 year/1 year	3 years/5 years	3 years/5 years	1 year/1 year
On-site service charge	Included (1 year)	Included (1 year)	\$79.95 (1 year)	Included (1 year)	Included (1 year)	\$75 (1 year)	\$75 (1 year)	\$199 (4 years)

Multiwave Technology

Ultra Power 133

At a street price of \$3,199 for a 133-MHz Pentium-based PC with average performance and an adequate set of components, the Ultra Power 133, from Multiwave Technology, is a reasonable choice. Multiwave, a wholesale distributor, went into the end-user market earlier this year. The company sells to corporate and individual customers.

IN SHORT

An average performer with a high-quality CD-ROM drive at a good price.

Our midsize tower test system came with a 1.2GB IDE hard disk, a TEAC 6X CD-ROM drive, a Diamond Stealth 64 Video VRAM graphics board with 2MB of VRAM, and a 14.4-Kbps fax modem.

Multiwave, an authorized distributor for Acer America Corp., uses many Acer components in its own units. The Ultra Power came with an Acer motherboard and a 17-inch AcerView 76i monitor. It used a Sound Blaster 16 sound card.

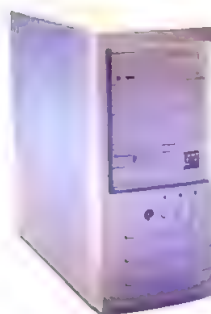
The Ultra Power was an av-

erage performer on our Winstone 96 and Graphics WinMark 96 tests, but posted one of the best CD-ROM WinMark 96 scores in this roundup. The system's Disk WinMark 96 score was below average for its class.

Multiwave backs its unit with a one-year warranty. On-site service is \$30 for the first year.—RSA

Multiwave Technology, City of Industry, CA; 800-234-3358, 818-330-7030; fax, 818-333-4609.

Circle 499 on reader service card



Quantex OPS/100 M-4	Quantex OPS/133 SM-2	Robotech Cobra XL P100	Robotech Cobra XL P133	Robotech Cobra XLT P100	Robotech Cobra XLT P133	SMD Mount Lesson	SMD Mount Shasta	Sys Performance P100T	Sys Performance P133T
\$2,299	\$3,399	\$3,019	\$3,249	\$3,269	\$3,499	\$2,150	\$3,695	\$2,299	\$2,799
Pentium/100	Pentium/133	Pentium/100	Pentium/133	Pentium/100	Pentium/133	Pentium/80	Pentium/133	Pentium/100	Pentium/133
16MB	16MB EDO	16MB	16MB	16MB EDO	16MB EDO	16MB	16MB EDO	16MB	16MB EDO
1.2GB EIDE	1.5GB EIDE	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1.2GB EIDE	1.5GB EIDE	1GB Fast ATA-2	1GB Fast ATA-2
STB Powergraph 64 Video	ATI Graphics Pro Turbo	Number Nine Vision 330	Number Nine Vision 330	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 Video VRAM	Diamond Stealth 64 DRAM	ASUSTek PCI-AV868	Diamond Stealth 64 DRAM	Diamond Stealth 64 Video VRAM
2MB DRAM	2MB VRAM	2MB DRAM	2MB DRAM	2MB VRAM	2MB VRAM	1MB DRAM	2MB DRAM	2MB DRAM	2MB VRAM
MAG InnoVision DX15Fe (15")	MAG InnoVision DX17F (17")	Pacom EZ17 (17")	Pacom EZ17 (17")	Pacom EZ17 (17")	Pacom EZ17 (17")	ADI MicroScan 4GP (14")	ADI MicroScan 5EP (17")	KFC CA1507 (15")	KFC CA1507 (15")
Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302B	Toshiba XM-5302B
4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI
Ensoniq Soundscape	Ensoniq Soundscape	Cobra Wave 16	Cobra Wave 16	Cobra Wave 16	Cobra Wave 16	Creative Labs CT2800	ASUSTek PCI-AV868	Acer Sarnik ECS 83051	Creative Labs Sound Blaster 16
ISA card	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card	Proprietary	ISA card	SCSI-2 ISA Card
■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
7.0, Win 95	7.0, Win 95	7.0, dual boot	7.0, dual boot	7.0, dual boot	7.0, dual boot	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95
256K asynchronous	256K synchronous	256K synchronous	256K synchronous	256K synchronous	256K synchronous	256K synchronous	256K pipelined burst	512K pipelined burst	512K synchronous
Biostar	Intel	Robotech	Robotech	Tyan	Tyan	ASUSTek	ASUSTek	ASUSTek	Tyan
Intel Triton	Intel Triton	SIS ASC550ax	SIS ASC550x	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton	Intel Triton
Award (8/2/95)	AMI (5/17/95)	Award (6/13/95)	Award (6/13/95)	Award (5/29/95)	Award (5/29/95)	Award (5/12/95)	Award (5/12/95)	Award (5/12/95)	Award (7/25/96)
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB	128MB
4 ISA, 3 PCI	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI	4 ISA, 4 PCI	3 ISA, 1 local bus, 3 PCI, 1 PCI/ISA	3 ISA, 1 local bus, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI
5, 1	5, 1	4, 1	4, 1	4, 1	4, 1	3, 2	3, 2	3, 2	3, 2
1, 5	1, 5	0, 4	0, 4	0, 4	0, 3	0, 2	0, 3	0, 2	0, 2
200W	200W	250W	250W	250W	250W	250W	250W	230W	250W
1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
■	■	■	■	■	■	■	■	■	■
1 year/1 year	1 year/1 year	2 years/lifetime	2 years/lifetime	2 years/lifetime	2 years/lifetime	1 year/1 year	1 year/1 year	Varies/1 year	Varies/1 year
Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	\$45 (1 year)	\$45 (1 year)	\$95 (1 year)	\$95 (1 year)

NEC Technologies Inc. **PowerMate V100, PowerMate P133**

NEC recently upgraded its PC line for greater appeal among corporate users, and these two mini-tower models show it. Both have competitive street prices—\$3,778 for the PowerMate P133, \$3,328 for the PowerMate V100—and are good performers. NEC also sells the Ready line of home PCs.

Though aimed at the corporate market, both units have easy-setup features. Both come with color-coded cables and a

quick-setup poster, and feature a thumb-screw case that provides easy access to components. The units also offer DMI support with MIF browsers, as well as client drivers for NetWare and Microsoft Windows NT.

The Pentium/133-based P133 came equipped with a 1.5GB hard disk, an NEC 6X CD-ROM drive, and an on-board S3 Trio 64V+ graphics chip set—plus a Mediamatics driver that provides MPEG playback support for smooth, full-screen video performance. An integrated Creative Labs Vibra 16 chip set delivers reliable sound.

The unit also featured an infrared port, an Ethernet adapter, and a helpful array of software utilities, including Intel's ProShare whiteboard program. On our benchmark tests, the P133 turned in an above-average Winstone 96 score. Other Windows-based test scores were average for the PC's processor class.

The Pentium/100-based Power-





Welcome
to

THE BOWTIE

The Gateway Solo™ 120 Best Buy portable PC is sold with a 14.4 PCMCIA fax/modem. The accompanying ad insert incorrectly states that it is sold with a 28.8 PCMCIA fax/modem.



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8930 FORMS PRINTER UNDER \$2,500

*Prints up to 9-part business forms
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*600 dpi, 8 or 12 ppm, PostScript®
Windows/DOS/Mac compatible*

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SUMMARY OF FEATURES

Windows 95 Pentium PCs

■ YES ■ NO

Products listed in alphabetical order by company

	Tagram Thunderbolt P100	Tagram Thunderbolt P133	Tangent MediaStar 590/95	Tangent MediaStar 5133/95	Tatung UNIQ 5510 Pentium 90	Tatung UNIQ 5210 Pentium 120	Unisys PW ² Advantage Super Series CWP51336	Unitek Thunderstreak Pentium 133
Street price (tested configuration)	\$2,745	\$3,095	\$2,295	\$2,995	\$2,700	\$2,995	\$3,882	\$2,889
Processor	Pentium/100	Pentium/133	Pentium/90	Pentium/133	Pentium/90	Pentium/120	Pentium/133	Pentium/133
Installed RAM	16MB EDO	16MB EDO	16MB EDO	16MB EDO	16MB	16MB	16MB	16MB EDO
Hard disk capacity and interface	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1GB Fast ATA-2	1.2GB EIDE	1.2GB EIDE	1GB SCSI	1.5GB EIDE
Graphics adapter	Matrox MGA Millennium	Matrox MGA Millennium	STB Powergraph 64 Video	STB Powergraph 64 Video	Integrated S3 Trio64	Integrated S3 Trio64	Number Nine Motion 771	Diamond Stealth 64 Video VRAM
Memory on graphics adapter	2MB WRAM	4MB WRAM	2MB EDO DRAM	2MB EDO DRAM	1MB DRAM	1MB DRAM	4MB VRAM	2MB VRAM
Monitor (and diagonal screen size)	MAG InnoVision DX17F (17")	MAG InnoVision DX17F (17")	ADI MicroScan 4GP (15")	ADI MicroScan 5EP (17")	Tatung CM15VBE (15")	Tatung CM15VBE (15")	Unisys EVG-500-COL (17")	ViewSonic 17GA (17")
CD-ROM drive	Toshiba XM-5302B	TEAC CD-56E	Mitsumi CRMC-FX400	Mitsumi CRMC-FX400	Mitsumi CRMC-FX400	Mitsumi CRMC-FX400	Toshiba XM-5302B	Toshiba XM-5302B
Drive speed and interface	4x ATAPI	6x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI
Sound adapter	Creative Labs Sound Blaster 16	Creative Labs Sound Blaster 16	Creative Labs CT2800	Creative Labs CT2800	SIC Media Sound 16	SIC Media Sound 16	Creative Labs CT2260	Creative Labs Vibra 16
Sound adapter interface	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card	ISA card	Motherboard
Speakers/network adapter/modem included	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
DOS, Windows version included	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95	7.0, Win 95
Motherboard Components								
Installed external RAM cache and type	256K pipelined burst	256K pipelined burst	256K synchronous	512K synchronous	256K asynchronous	256K asynchronous	512K asynchronous	256K synchronous
Motherboard manufacturer	BCM	Tyan	Tyan	Tyan	Tatung	Tatung	FIC	Intel
Chip set manufacturer and model	Intel Triton	Intel Triton	Intel Triton	Intel Triton	VLSI VL82C59x	VLSI VL82C59x	Intel Triton	Intel Triton
BIOS manufacturer and version (or date)	Award (7/3/95)	Award (6/30/95)	Award (7/25/95)	Award (7/25/95)	Phoenix (3/20/95)	Phoenix (5/30/95)	Award (5/22/95)	AMI (5/17/95)
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■	■
Expandability								
Maximum RAM	128MB	128MB	128MB	128MB	768MB	768MB	128MB	128MB
Expansion bus slots	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 4 PCI	4 ISA, 4 PCI	4 ISA, 4 PCI	2 ISA, 2 PCI	2 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	3, 2	4, 1	2, 1	2, 1	2, 1	2, 2	3, 0	3, 1
Internal drive bays (5.25", 3.5")	0, 2	0, 4	0, 2	0, 2	0, 1	0, 3	0, 2	0, 1
Power-supply wattage	230W	250W	230W	230W	205W	200W	200W	230W
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support								
7-day, 24-hour live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	2 years/2 years	2 years/2 years	3 years/3 years	1 year/1 year
On-site service charge	\$65 (1 year)	\$65 (1 year)	Included (1 year)	Included (1 year)	N/A	N/A	\$348 (1 year)	\$75 (1 year)

N/A—Not applicable: The product does not have this feature.

Mate V100 comes with the same soft-

IN SHORT

NEC's systems are solid platforms with forward-looking features.

SERVICE & RELIABILITY
NEC Technologies Inc.

Reliability	Average
Repair	Average
Technical support	Average
Percent needing repair	Better than average

ware as its more expensive sibling, but there are a couple of hardware differences between the two models. For example, the PowerMate V100 gets on-board graphics and sound from Alliance ProMotion-6422 and OPTi chip sets, respec-

tively. But there are similarities as well: Like the P133, the V100 has software-based MPEG support.

The V100's Winstone score was average, and its Quantum Fireball hard disk came through, helping it earn an above-average Disk WinMark 96 score. The unit's Graphics WinMark 96 score was below average, however.

NEC offers a three-year warranty—including one year of on-site service—with both PowerMate PCs.—*JRQ*
NEC Technologies Inc., Mountain View, CA; 800-632-4636; fax, 800-366-0476.

Circle 473 on reader service card

NETis Technology Inc.

Budget N5100P

The \$2,195 Budget N5100P, from NETis Technology, contains the basic necessities to make Windows 95 run—but NETis fails to support the system's 100-MHz Pentium processor properly for peak performance.

The primary shortcomings of this mini-tower system are its use of standard DRAM (rather than faster EDO

IN SHORT

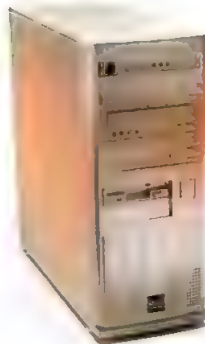
A slow memory subsystem hampers the performance of this machine.

Mark 96 score was also below average, though its Disk WinMark 96 score was average.

The N5100P comes with a warranty that covers parts for one year, and labor for two. On-site service is included for the first year.—JRQ

NETis Technology Inc., Milpitas, CA; 800 577-7526, 408-263-0368; fax, 408-263-4624.

Circle 500 on reader service card



on our Windows-based tests, helping the Daytona earn the best results in its small class. The unit also did well on our multimedia tests.

The system comes with a two-year parts-and-labor warranty. On-site service is \$79.95 for the first year.—JRQ

PacTron Integration Inc., Chathsworth, CA; 800-775-8766, 818-700-1259; fax, 818-700-1303

Circle 501 on reader service card

PerComp Microsystems Inc.

P100 Professional, P133 Professional

With the \$3,999 P133 Professional and the \$3,199 P100 Professional, PerComp Microsystems provides a Pentium/133 desktop and a Pentium/100 tower with reasonable performance. The P133, however, is truly loaded, with hardware such as a tape backup drive and two CD-ROM drives. It is aimed at networked power users, while the P100 is targeted at



individual home or business users.

The P133 came with a Colorado T1000 Travan tape drive, and two quad-speed CD-ROM drives—one labeled “CD Audio” and the other “CD Data Only.” If you’re playing only one CD, you can put an audio or data CD in either drive, but you cannot play two audio CDs simultaneously.

The P133 featured a Diamond Stealth 64 Video VRAM graphics board with 4MB of VRAM, a Logitech SoundMan wavetable sound board, a 28.8-/14.4-Kbps data/fax modem, and a 3Com EtherLink III Ethernet card. Its less expensive sibling, the P100, came with the same hard disk, network card, and sound board, but lacked a tape drive and a second quad-speed CD-ROM drive. The P100 featured a Diamond Stealth graphics card with 2MB of VRAM and used a 14.4-Kbps fax modem.

The two systems posted average scores

PacTron Integration Inc.

DaytonaWin-120NX

The Pentium/120-based DaytonaWin-120NX, from PacTron Integration, has two great things going for it: a price of \$2,750 and good performance for its 120-MHz class. PacTron also includes a 28.8-/14.4-Kbps data/fax modem in the package. This system is aimed at corporate and government users. In addition to the unit we reviewed, PacTron offers the multimedia-ready MultiPak line of home PCs, the Tornado line of small-office/home-office PCs, and the Moti File Server line of high-end PCs for networked business users.

One of five 120-MHz Pentium-based systems in this roundup, the Daytona offers a good array of peripherals. The machine covers the CPU’s demands with EDO DRAM and 256K of pipelined-burst L2 cache. The desktop PC comes with a 1.2GB Conner hard disk and a quad-speed CD-ROM drive. For sound and video, the system uses a Creative Labs Vibra 16 card and a Diamond Stealth64 Video VRAM board with 4MB of VRAM.

These components worked well

IN SHORT

All the basics are here—including great performance—at a great price.

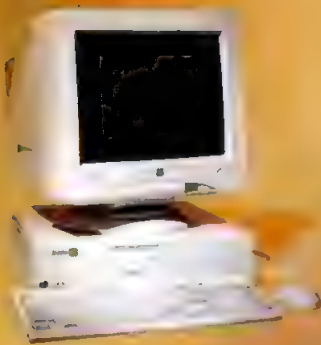


IN SHORT

Both PCs offer average performance; the P133’s extras spotlight it.

DRAM) and its less-than-optimal 256K of asynchronous cache, which hampered the CPU subsystem. The unit’s graphics subsystem is based on a slower DRAM-based Diamond Stealth Video adapter. A 1.6GB hard disk and a Sound Blaster-compatible sound card round out the package.

The N5100P revealed its blemishes in several performance tests. On our video playback tests, the system dropped frames in one of the tests (although it was not the most egregious offender in this regard). In addition, the PC’s poor CPU performance degraded overall performance on Winstone 96 tests. The unit’s Graphics Win-



Its powerful,
Pentium[®] processor pose.



Its aggressive,
3-year limited warranty look.



Its prudent,
value-minded side.

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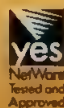
Its reliable, service
and support stance.



Its plug and
playful look.



Its serious,
hardworking, upgrade look.



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Its "bring on
Windows 95" pose.



Its sensitive,
budget-conscious side.



Its sincere,
tested and certified look.



Its "known around
the world" look.



Its flexible, grow-how-
you-want-it pose.



And its quiet,
end of the day pose.

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for their respective CPU classes on our Winstone 96 and CD-ROM WinMark 96 tests. The P100 turned in above-average scores on both our Graphics WinMark 96 and Disk WinMark 96 tests. The P133 posted an average Graphics WinMark score and a below-average Disk WinMark score for its class.

Both units come with a one-year warranty with a year of on-site service.—**RSA PerComp Microsystems Inc., Richardson, TX; 800-856-6688, 214-234-2198; fax, 214-234-8658.**

Circle 502 on reader service card

Polywell Computers Inc.

Poly 5100T3, Poly 5133T3

Polywell Computers manages to fill the 133-MHz and 100-MHz Pentium PC tiers with two aggressively priced machines: the \$2,995 Poly 5133T3 and the \$2,555 Poly 5100T3. Both systems performed reasonably well on our tests, but the Poly 5100T3 was a standout in its processor class. Polywell aims both the top-of-the-line Poly 5133T3 and the midrange Poly 5100T3 at individual home and business power users.

Both systems used the same midtower case and were similarly configured. Each came with a 1GB Quantum Fireball IDE hard disk, a Creative Labs Sound Blaster 16 sound board, and a Microsoft-style ergonomic keyboard.

The only major difference between the systems was the graphics card: The Poly 5133T3 used a Diamond Stealth

64 Video VRAM board with 2MB of VRAM, while the Poly 5100T3 came with a Diamond Stealth64 Video DRAM card with 2MB of DRAM.

Both machines were respectable performers. The Poly 5100T3 did especially well, generating above-average scores for its class on our Winstone 96 and Graphics WinMark 96 tests. The



IN SHORT

Both Polywells offer a good mix of performance and aggressive pricing.

Poly 5133T3 was an average performer on these tests. Both systems posted Disk WinMark 96 test scores near the top of their respective processor classes.

The warranty on these units covers parts for three years and labor for five. On-site service is \$75 for the first year.—**RSA Polywell Computers Inc., South San Francisco, CA; 800-999-1278, 415-583-7222; fax, 415-583-1974.**

Circle 503 on reader service card

Premio Express Inc.

Express Station P133

The \$2,599 Express Station P133, sold direct by Premio Express, is a good value, offering average performance and a good software bundle. Premio positions its 133-MHz Pentium system as a high-performance corporate and small-office/home-office machine. The company also sells the home-oriented Rocket PC line (not reviewed).

The P133 system came with a CompuTrend ISA/PCI-based motherboard, which uses a Triton chip set, 256K pipelined-burst L2 cache, and EDO DRAM. The unit also includes a 15-inch monitor, a GoldStar quad-speed CD-ROM drive, a Creative Labs CT2260 audio board, and a pair of 30-watt speakers. Premio bundles the Novell Perfect Office 3.0 suite with the PC.

IN SHORT

This solid performer offers a good blend of software and hardware.

A 1GB Quantum Fireball hard disk helped the unit to an above-average Disk WinMark 96 score.

With its ATI mach-64-based ATI Graphics Xpression graphics card with 2MB VRAM, the system posted an average Graphics WinMark 96 score. Its Winstone 96 score was also average.

A one-year warranty is standard; four years of on-site service costs \$199.—**BB Premio Express Inc., City of Industry, CA; 800-834-4558, 818-336-2184; fax, 818-336-4374.**

Circle 504 on reader service card



Quantex Microsystems Inc.

QP5/133 SM-2, QP5/100 M-4

Quantex Microsystems' Pentium/133-based QP5/133 SM-2 (\$3,399) and Pentium/100-based QP5/100 M-4 (\$2,299) offer average performance and come with good software bundles and fax modems. Quantex is a mail-order vendor and has been marketing its own PCs since 1991. The high-end QP5/133 is meant as a professional system while the midrange QP5/100 is aimed at small-office/home-office users as well as families. The company also sells high-end business workstations, entry-level workstations, and home PCs.

Designed around an Intel motherboard, the QP5/133 SM-2 came with a 1.5GB Enhanced IDE hard disk, an ATI mach64-based graphics board with 2MB of VRAM, a 17-inch monitor, and a 28.8-/14.4-Kbps data/fax modem. It also featured a wavetable synthesis-capable sound card and good speakers: A set of Altec Lansing ACS-31 speakers with subwoofer.

The QP5/100 M-4 used the same sound board, but came with a Biostar motherboard, a slightly smaller hard disk, a 15-inch monitor, an STB PowerGraph 64 graphics board with 2MB of DRAM, and a 14.4-Kbps fax modem. It shipped with Altec Lansing ACS-5 speakers, which don't include a subwoofer.

Both machines also provided a good deal of software. The QP5/133 SM-2 included business-oriented titles such as Phone Disc Business Lite and Novell's Perfect Office. The QP5/100 M-4's bundle was home-oriented, with software such as Hometown Weekend Projects and Mayo Family Pharmacy. The more office-oriented bundle costs an additional \$50.

Both Quantex PCs logged average scores across all of our Windows-based benchmark tests. The units come with a



IN SHORT

Both Quantex units offer average performance and a good software bundle.



Jim Rue

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- ▶ Tours the Louvre.
- ▶ Downloads Miles Davis.
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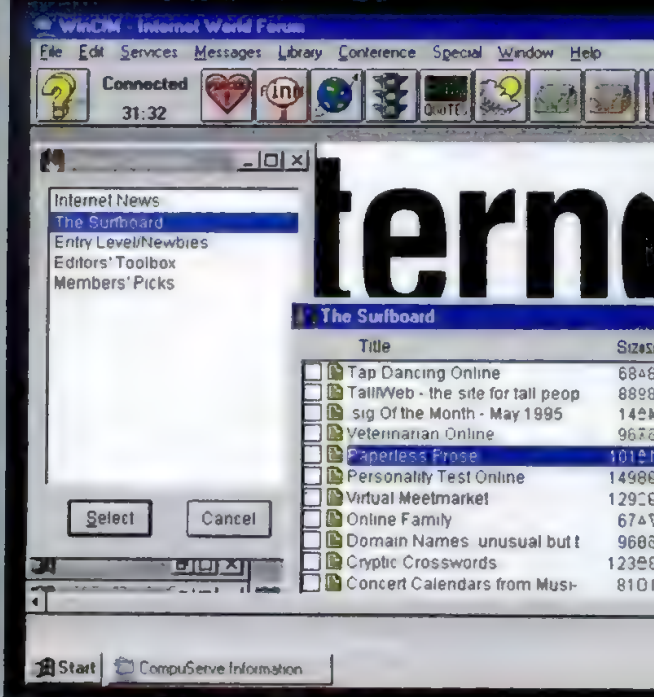


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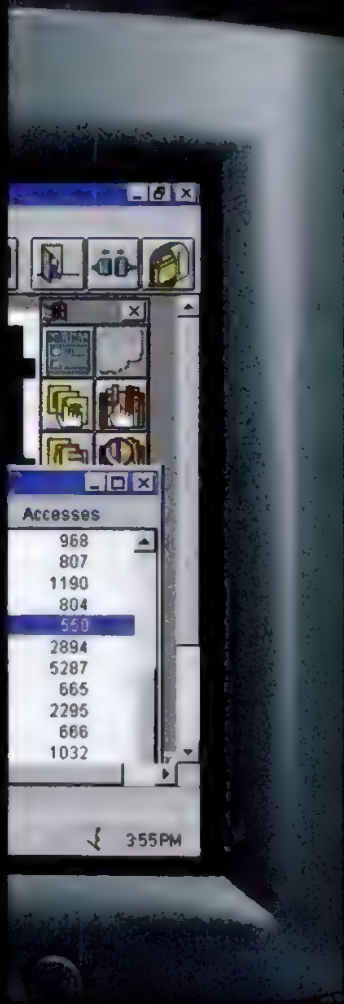
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Quantex Microsystems Inc., Somerset, NJ; 800-613-2047, 908-563-4166; fax, 908-563-0407.

Circle 505 on reader service card

Robotech Inc.

Cobra XL P100, Cobra XL P133, Cobra XLT P100, Cobra XLT P133

Robotech's \$3,019 Cobra XL P100 and \$3,249 Cobra XL P133 come with some good hardware, but their low test scores suggest that you look to the company's higher-end Cobra XLT line for a better return for your money. The \$3,269 Cobra XLT P100 and \$3,499 Cobra XLT P133, part of Robotech's high-performance-line, are adequate—though not stellar—performers.

Both Cobra XLTs have Triton-based motherboards with EDO DRAM and the same 256K synchronous L2 cache used in the Cobra XL series (the XLT's use an Intel cache controller, however). Paired with 1GB Quantum Fireball hard disks and S3 Vision968-based Diamond Stealth64 Video VRAM graphics adapters with 2MB of VRAM, both XLTs posted good results for their respective CPU classes on all of our benchmark tests. The highlight of the XLT P100's performance was its above-average Graphics WinMark 96 score.

The Cobra XLs use Robotech motherboards with SiS chip sets, 256K synchronous L2 cache, and standard DRAM. This platform is a slow base for an otherwise high-performing 1GB Quantum Fireball hard disk, and helped drag both units' Disk WinMark 96 scores to below average in their respective CPU classes. Each system also has a Number Nine Vision 330 graphics adapter with 2MB of DRAM. Using this graphics subsys-

tem, the PCs had the lowest Graphics WinMark scores in their respective categories. The XL P100's Winstone 96 score was also below average, while the XL P133's score was the lowest in its group.

The XL systems turned in the worst performance of all reviewed units on our multimedia tests, with a very high number of video-frame drops and exceptionally blocky full-screen scaling results.

In contrast, the Cobra XLT models had no reported or visible video-frame drops, and performed well on multimedia-scaling, color-palette, and lip-synchronization tests.

Robotech includes an American Power Conversion surge protector power strip with each system. All four systems also came with 17-inch monitors, as well as Toshiba quad-speed CD-ROM drives, 16-bit audio cards, and 10-watt Yamaha speakers. Bundled software includes Novell's Perfect Office suite.

Both sets of systems have a two-year-parts, lifetime-labor warranty with on-site service included for the first year. For an additional \$199, you can extend the parts warranty for two more years and buy three more years of on-site service.—*BB*

Robotech Inc., Midvale, UT; 800-533-0633, 801-565-0645; fax, 801-565-0680.

Circle 506 on reader service card

Summit Micro Design Inc.

SMD Mount Lassen, SMD Mount Shasta

Whereas Summit Micro Design's 133-MHz Pentium-based SMD Mount Shasta mini-tower (\$3,695 street price) yielded excellent scores on our benchmark tests, the 90-MHz Pentium-based SMD Mount Lassen desktop (\$2,150 street price) came up short. Both units are aimed at the corporate market; the company also offers a line of multi-processing-capable PCs for high-end corporate functions.

Both of the units we reviewed offered a Media Expansion Slot, which is a PCI slot with an ISA extension. While it can be used with standard PCI devices, the slot is designed for boards like the ASUS VideoMagic PCI-AV868 combination graphics/audio card, which came with the SMD Mount Shasta.

This ASUS combination board has an

S3 Vision868 64-bit graphics chip set, an 170-MHz AT&T 409 24-bit true-color RAM-DAC and 2MB of EDO DRAM for video. FM-synthesis audio is controlled by a Creative Labs Vibra 16S audio chip. The Mount Lassen used a Diamond Stealth-64 DRAM PCI graphics board with 1MB of DRAM and a separate sound card. The Mount Shasta also came with a 28.8-Kbps fax modem.

The Mount Shasta posted one of the best Winstone 96 scores in this roundup. Its Disk WinMark 96 and Graphics WinMark 96 scores were average.

The Mount Lassen was a whole other story: It posted the lowest Winstone 96 score in its CPU class and logged below-average Disk WinMark and Graphics WinMark scores. Its budget-oriented Conner CFS 1275A hard disk and DRAM-based graphics card didn't help the unit keep up with others in its class.

Both SMD PCs come with a one-year warranty. On-site service is \$45 for the first year.—*RSA*

Summit Micro Design Inc., Sunnyvale, CA; 800-288-5828, 408-739-6348; fax, 408-739-4643.

Circle 507 on reader service card

Sys Technology Inc.

Sys Performance P100T, Sys Performance P133T

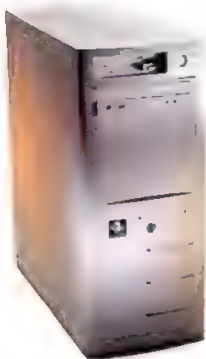
Sys Technology touts its \$2,299 100-MHz Sys Performance P100T and \$2,799 133-MHz Sys Performance P133T as value-oriented, high-end performers. The units' prices and benchmark test results bear that claim out. Sys aims these systems at corporate power users.

The P100T used an ASUSTek motherboard with Intel's Triton chip set, 512K of pipelined-burst L2 cache, and standard DRAM. This motherboard, combined with a 1GB Quantum Fireball hard disk and a Diamond Stealth64 Video DRAM



IN SHORT

The Mount Shasta's performance shines, but the Mount Lassen's doesn't.



IN SHORT

If you want good performance from a Robotech PC, look to the XLT line.

graphics adapter with 2MB DRAM, made the P100T an able competitor in its class. It earned the highest Winstone 96 score of all the 100-MHz machines we tested and above-average Disk WinMark 96 and Graphics WinMark 96 scores.

The P133T used a Tyan motherboard with 512K synchronous L2 cache and EDO DRAM. It used the same hard disk as the P100T, but had a graphics card with 2MB of VRAM. These components helped the P133T garner an above-average Disk WinMark score and average Winstone and Graphics WinMark results.

Users should like the units' cases,

which feature easy-slide-out motherboards. Both models also come with Toshiba CD-ROM drives (quad-speed for the P100T and 4.4X for the P133T) and 80-watt speakers. These speakers have lots of power but otherwise are only incrementally better than standard bundled speakers. Both units posted good results on our multimedia tests.

Sys warranties the system pieces separately, according to the individual warranties of the original component manufacturers. An on-site service contract is available for one year for \$95.—BB

Sys Technology Inc., Cypress, CA; 800-613-9963, 714-821-3900; fax, 714-821-9592.

Circle 515 on reader service card

Tagram System Corp.

Tagram Thunderbolt P100, Tagram Thunderbolt P133

The 100-MHz Tagram Thunderbolt P100 (\$2,745) and 133-MHz Tagram Thunderbolt P133 (\$3,095), from Tagram System Corp., emphasize graphics capabilities with bundled 17-inch monitors and above-average graphics test scores. These PCs are targeted at small-office/home-office and family users. Tagram also offers several other lines: The Office Tools line of workstations for large businesses, the Creative Tools line for the graphics

market, and the Thunderbolt Personal Tools line for the home market.

Both of the PCs we tested used Triton-based motherboards with EDO DRAM and 256K of pipelined-burst L2 cache. Each model also came with a 1GB Quantum Fireball hard disk and a Matrox Millenium graphics card (the P100's card had 2MB of RAM while the P133's had 4MB). A quad-speed Toshiba CD-ROM drive on the P100 and a TEAC 6X CD-ROM drive on the P133 round out each package.

The P100 desktop achieved the highest Graphics WinMark 96 score in its class and an above-average Disk WinMark 96 score. Its Winstone 96 score was average. The P133 tower posted above-average Graphics WinMark and Disk WinMark scores for its CPU group, as well as an average Winstone result. Multimedia tests with both PCs resulted in no visible drops in video frames, and good lip sync and color.

Tagram provides a three-year warranty for these systems; one year of on-site service is optional for \$65.—BB

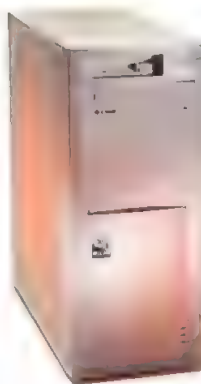
Tagram System Corp., Tustin, CA; 800-824-7267, 714-258-3222; fax, 714-258-3220.

Circle 516 on reader service card

Tangent Computer Inc.

MediaStar 590/95, MediaStar 5133/95

Tangent Computer's MediaStar 5133/95 (\$2,995) and MediaStar 590/95 (\$2,295) both offer attractive prices and strong performance. Tangent set out to build Windows 95 dream ma-



IN SHORT

These units are competitively priced and well configured for graphics work.

chines by using 32-bit, Windows 95-supported components and drivers. This approach netted the 90-MHz MediaStar 590/95 top performance honors in all major categories, and helped the 133-MHz MediaStar 5133/95 attain strong test scores. The 5133/95 is geared for power users, while the 590/95 works well in a mainstream corporate environment.

Both units use Triton-based motherboards with synchronous L2 cache (256K on the 590/95 and 512K on the 5133/95) and EDO DRAM. Each comes equipped with a 1GB Quantum Fireball hard disk and an STB Powergraph Video 64 graphics adapter with 2MB of EDO DRAM. The 5133/95 also packs a slightly larger monitor than its less expensive sibling (17-inch versus 15-inch on the 590/95).

These components helped the 590/95 turn in the highest Disk WinMark 96, Graphics WinMark 96, and Winstone 96 scores for its class. The 5133/95's Windows-based test scores were all average. Neither machine dropped video frames on our multimedia tests. When scaled to full-screen size the test image was noticeably blocky.

Each model included a wavetable Sound Blaster 16 audio card and internal 10-watt speakers. Audio jacks, audio tuning, and volume controls are on the front of the desktop case.

Both units come with a three-year warranty with one year of on-site service.—BB

Tangent Computer Inc., Burlingame, CA; 800-974-6658, 415-342-9388; fax, 415-342-9380.

Circle 517 on reader service card

Tatung Company of America Inc.

UNIQ 5510 Pentium 90, UNIQ 5210 Pentium 120

It's a good indication that something is not right when your 120-MHz Pentium PC performs on a par with a 90-MHz Pentium system. The \$2,995 UNIQ 5210 Pentium 120 did exactly that—mostly because of poorly chosen components. Tatung's \$2,700 UNIQ 5510 Pentium 90 did not fare much better: Its scores were below average for its processor class.

IN SHORT

Well-chosen parts led to terrific performance for these machines.



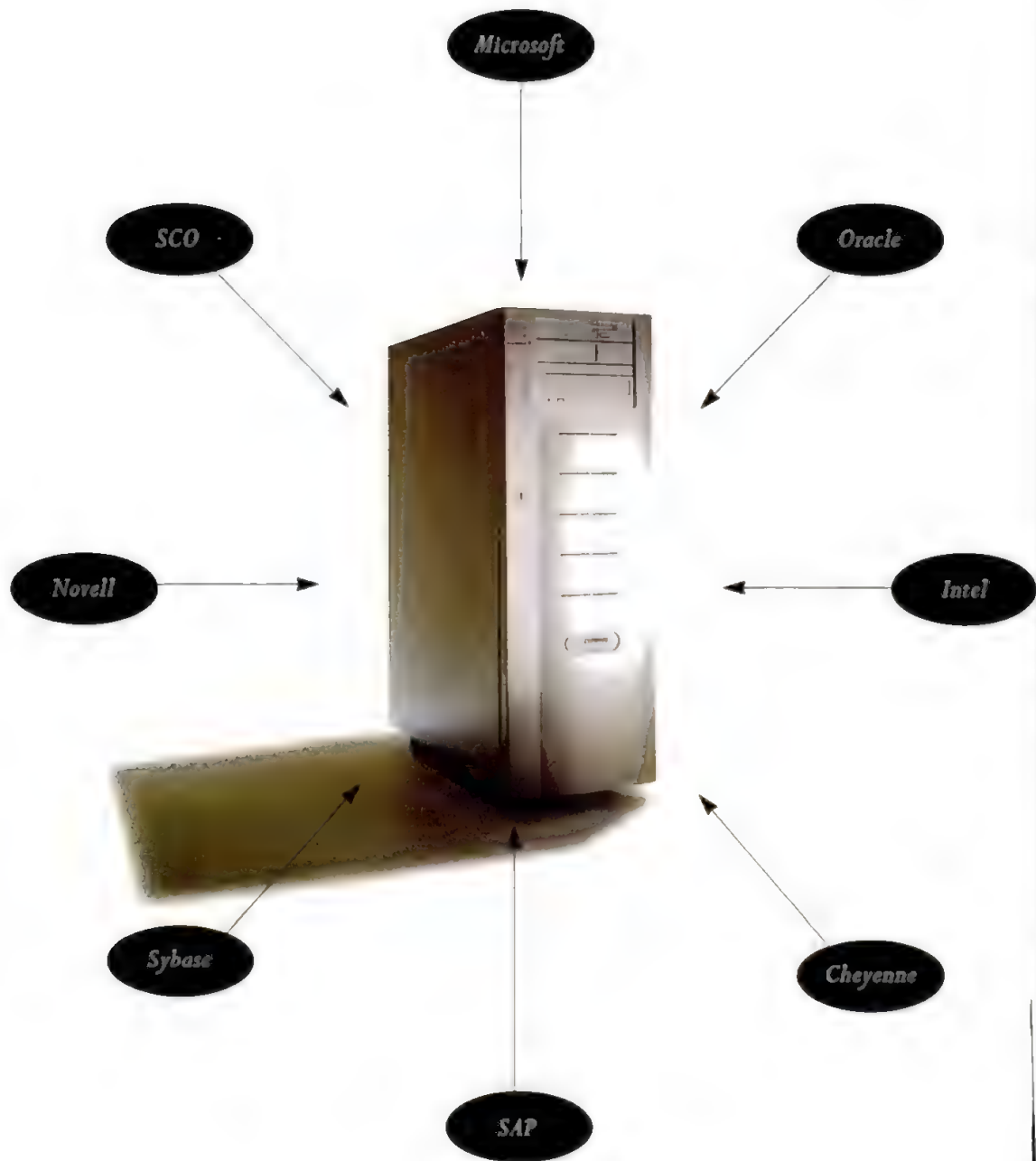
IN SHORT

These systems deliver high performance at eye-opening low prices.



SERVICES *are* BUILT by TEAMS of PEOPLE

SOLUTIONS



SOLUTIONS *are* BUILT *by* TEAMS *of* COMPANIES.

Any computer company can build hardware that runs software that runs your business. Or can it? After all, this is your business we're talking about here. Do you really want to trust it to mere hardware? At Compaq, we're betting you'd prefer an easy-to-use, fully thought-out solution. A solution that is the right combination of server, operating system, and database application that solves the puzzle of your varied computing needs.

Well, that takes several companies. Companies like Microsoft, with whom we created the ideal platform for Windows NT and BackOffice, integrating hardware, software, and server management. Novell, with whom we've created networking standards for years. Oracle, whose databases are far easier to deploy on a Compaq server thanks to our partnership. And SAP, a leader in client/server applications, who's named us Partner of the Year.

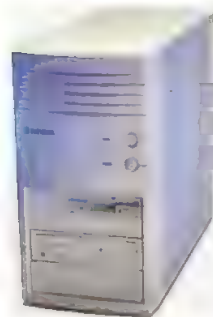
You see, they may be Compaq servers. But they are Compaq-Microsoft-Oracle-SAP-Intel-Novell-SCO-Sybase-Cheyenne solutions. (We just couldn't fit all those logos on them.)

COMPAQ

Has It Changed Your Life Yet?

Both systems are aimed at the corporate and small business markets. Tatung also markets an All-in-One Multimedia PC value line targeting students and home users.

Both units use the same motherboard and both suffer from overcrowding. The 5510 slimline system has messy cabling and memory access is blocked by the floppy disk drive. Though the 120-MHz model features a mini-tower case, it has the same problem as its sibling: Access to the memory banks is blocked by a drive bay cage.



IN SHORT

Poor component choices resulted in bottom-tier performance for both PCs.

The 5210 posted the lowest scores within the 120-MHz Pentium group. In fact, the unit's performance was barely average when compared with that of 90-

MHz systems across our Windows-based benchmark tests. The unit's VLSI chip set and asynchronous buffered write-through external processor cache are the primary culprits, as are the unit's DRAM-based video chip set and budget-oriented Conner CFS1275A hard disk. This hard disk is reasonably priced, but with a rotational speed of only 3,600 rpm, it just can't keep up with the faster hard disks used by the competition.

Within the 90-MHz group, the 5510 was among the poorest performers. Its scores on our Disk WinMark 96 and Graphics WinMark 96 tests were below average and its Winstone 96 score was barely average. The unit used the same VLSI chip sets, Conner hard disk, and DRAM-based graphics subsystem as the 120-MHz model.

Tatung provides a two-year parts-and-labor warranty with each of these UNIQ Pentium machines.—WPF

Tatung Company of America Inc., Long Beach, CA; 800-829-2850, 310-637-2105; fax, 310-637-8484.

Circle 518 on reader service card

Unisys Corp.

PW² Advantage Series, Model CWP 51336

Unisys Corp.'s \$3,882 Model CWP 51336, part of the company's PW² Advantage Series, had average test scores for its 133-MHz Pentium group and offers a good range of components, including a network card. Unisys has traditionally sold PCs to business users via a direct sales force and through VARs. Stressing its ability to customize systems, Unisys targets the CWP series at the business desktop Pentium market, having versions available with three- or six-PCI-slot motherboards.

The system uses an FIC motherboard with standard DRAM, 512K of asynchronous L2 cache, and the Intel Triton chip set. It comes with a Number Nine 9FX Motion 771 graphics adapter with an S3 Vision968 chip set and 4MB of VRAM, and an Adaptec EZ-SCSI Fast/Wide SCSI-2 adapter for its Seagate 1GB hard disk. These core components helped the CWP 51336 attain average scores across

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our Windows-based benchmark tests.

The system did well on all of our new multimedia tests also. Scaling up a small video image to full-screen size produced an image that looked significantly smoother and less blocky than on most systems, a testament to the unit's video card.

The Unisys machine also comes with a 17-inch Unisys monitor, a Toshiba quad-speed CD-ROM drive, and an SMC 8432/PCI Ethernet card.

IN SHORT

A network card and average performance make this an attractive system.

SERVICE & RELIABILITY

Unisys Corp.

Reliability	Worse than average
Repair	Average
Technical support	Average
Percent needing repair	Average



Unisys warrants the CWP 51336 for three years. On-site service from Unisys for one year costs \$348.—BB

Unisys Corp., Blue Bell, PA; 800-448-1424, 716-924-0480; fax, 716-742-6671.

Circle 519 on reader service card

Unitek Technology Inc.

Thunderstreak Pentium 133

The \$2,889 Thunderstreak Pentium 133 was a solidly average performer, and it delivers a lot of value for its purchase price. Unitek Technology targets power users in the government and home markets with this system.

The Thunderstreak uses an Intel motherboard with the Intel Triton chip set, 256K synchronous L2 cache, and EDO DRAM. These components contributed to the system's average Winstone 96 score. The unit's Western Digital Caviar 1.5GB hard disk and Diamond Stealth64 graphics adapter with 2MB VRAM helped it to achieve average Disk WinMark 96 and Graphics WinMark 96 scores. In multimedia testing, the Thunderstreak had no ob-

servable video frame drops and no audio drops.

The unit also came with a ViewSonic 17GA monitor with built-in speakers and microphone. The speakers are convenient but produced only moderate-quality sound. Other components include a Toshiba quad-speed CD-ROM drive and integrated Creative Labs Vibra 16 audio chip.

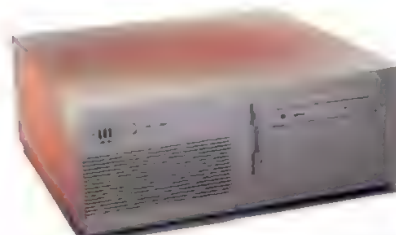
Unitek offers a one-year parts-and-labor warranty with the Thunderstreak system. On-site service for the first year is \$75.—BB

Unitek Technology Inc., Ontario, CA; 800-944-5650; fax, 909-930-5710.

Circle 520 on reader service card

IN SHORT

The system offers good performance at a very attractive price.



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Dell's featured computer artist is Glenn Mitsui of Studio MD, Seattle.

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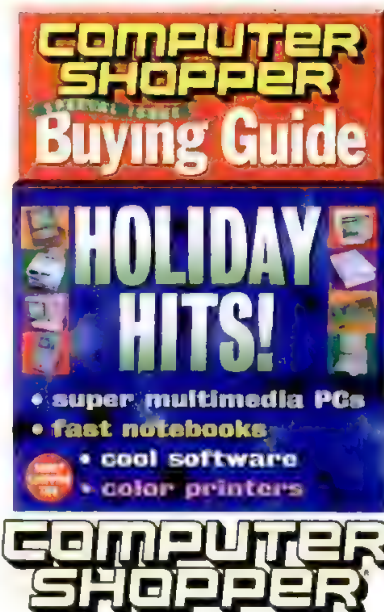


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USA Flex Inc.

Flex PT100 Business Workstation

Direct seller USA Flex targets knowledgeable small-/home-office buyers with good reason. Its 100-MHz \$2,799 Flex PT100 Business Workstation was an above-average performer and came loaded with all you will need for most applications, including a network card. The appeal of this system is marred only by the

company's poor results on *PC Magazine's* Service and Reliability survey.

The PT100 uses an Intel Triton-based motherboard with 256K of pipelined-burst L2 cache and EDO DRAM. A Western Digital Caviar 1.2GB hard disk and S3 Vision968-based Hercules Graphite Terminator Professional PCI graphics card with 2MB VRAM complete the major components list. This combination helped the unit attain above-average Winstone 96 and Graphics WinMark 96 scores for its class.

Its Disk WinMark 96 score was average.

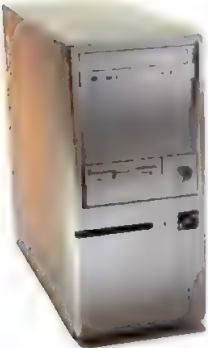
There were no perceptible video frames dropped. Video scaling was a bit blocky but better than in most systems.

The unit was packaged with a Turtle Beach Monte Carlo audio card capable of wavetable and FM synthesis and 16-watt speakers. USA Flex also included a 14.4-Kbps data/fax/voice modem and an Instant-Link Ethernet adapter with the system. The bundled software includes the Novell Perfect Office suite.

The Flex PT100 has a three-year warranty with on-site service included for the first year. Technical support is available 24 hours, 7 days.—BB

USA Flex Inc., Bloomingdale, IL; 800-872-3539, 708-582-6202; fax, 708-351-7204.

Circle 521 on reader service card



IN SHORT

An above-average performer on our tests, this PC is worth a closer look.

SERVICE & RELIABILITY USA Flex Inc.

Reliability	Average
Repair	Average
Technical support	Average
Percent needing repair	Worse than average

Vektron

Ultimate Power Station P133

Aimed at professional, computer-literate users who want the highest level of performance, Vektron's \$2,995 133-MHz Ultimate Power Station P133 is a good deal. It combines a relatively low price and high-end components with solidly average performance. Vektron also sells PCs configured for the small-office/home-office, a multimedia line for the home, and the PowerPlus line for heavy-duty graphics, which can be geared for MPEG and CAD work.

The unit used an Intel Triton-based motherboard and EDO DRAM. The motherboard also had 512K of pipelined-burst L2 cache, one of about a dozen machines at that level. Other speedy parts included a 1.5GB hard disk and an S3 Vision968-based Diamond Stealth64 Video VRAM card with 2MB of VRAM. These components helped the unit achieve average Winstone 96, Disk WinMark 96, and Graphics WinMark 96 scores.

Other hardware components included with the system are a Toshiba quad-speed CD-ROM drive, a Sound Blaster AWE32 wavetable audio card that supports FM and wavetable synthesis, and a microphone.

Multimedia testing yielded no perceptible dropping of video frames. Good lip synchronization, color palette activation, and audio quality were observed. When the video clip was scaled up to full-

screen mode, there was typical but not excessive blockiness.

The Vektron unit has a one-year parts and lifetime labor warranty. One year of on-site service is available for \$50; a four-year on-site package is \$199.—BB

Vektron, Grand Prairie, TX; 800-725-0009, 214-606-0280; fax, 214-606-1278.

Circle 522 on reader service card



IN SHORT

Vektron hits the mark with its Ultimate Power Station P133.

Wedge Technology Inc.

DeskMate Pro 133

Wedge Technology's \$4,158 DeskMate Pro 133 offers average performance and a few noteworthy extras such as a removable hard disk and a fax modem. Wedge Technology positions the Pentium/133-based DeskMate Pro as a high-end corporate PC.

The unit has an Intel Triton-based motherboard with 512K of pipelined-burst L2 cache and EDO DRAM. A removable Western Digital Caviar 1.5GB hard disk and an S3 Vision968-based Diamond Stealth64 Video VRAM board with 2MB VRAM are also included. These components helped the DeskMate attain respectably average Winstone 96, Disk WinMark 96, and Graphics WinMark 96 scores for its CPU class.

The Wedge Technology machine also came with a 15-inch Proton monitor with integrated speakers, a quad-speed Matsushita ATAPI CD-ROM drive, and Sound Blaster 16-compatible audio card. The unit also included a dual 1.2MB/1.44MB floppy disk drive. A 28.8/14.4-Kbps data/fax modem completes the hardware profile.

The system performed very well in both objective and subjective multimedia testing, with no video frames dropped, good lip synchronization, and color palette activation, and no dropped audio signals. Scaling the video image to full-screen size resulted in typical but not excessive blockiness.

Wedge Technology includes a one-year parts and three-year labor warranty with the DeskMate Pro. After the first year, you may purchase three years of on-site service from GE for \$359.—BB □

Wedge Technology Inc., Milpitas, CA; 800-872-9334, 408-263-9888; fax, 408-263-9886.

Circle 523 on reader service card



IN SHORT

The DeskMate Pro provides average performance and some useful extras.

What Can You Do With A \$100 Digital Video Camera?

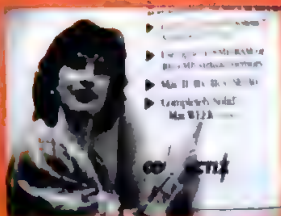
Shoot the Works.



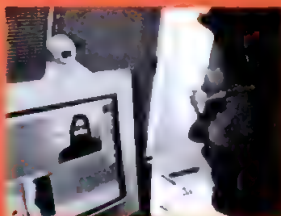
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System Requirements: A PC* equipped with a 386, 486, Pentium or equivalent processor • Windows 3.1 or 3.11 • Windows for Workgroups 3.1 or 3.11 • 4 MB RAM required.



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WINDOWS 3.X MACHINES

...Out like a Lamb?

These are the times that try the soul, especially if that soul works in an IS department. With the advent of Windows 95, some network administrators will choose to go bravely forward and upgrade to this new operating system, and will find themselves both rewarded and burdened with faster applications and unforeseen problems. Others will go slowly and stay the course with Windows 3.1x, waiting for others to debug Windows 95, or waiting for next year's budget. Or they may opt for Windows NT, an operating system whose networking support and security features are more robust than either Windows 3.x or Windows 95.

WHY WAIT?

Corporations may decide to stand pat for many reasons. And their reasons may have to do not with Windows 95's stability or even the availability of real 32-bit applications, but with the overall costs of upgrading both hardware and software. All in-house applications, both off-the-shelf and especially customized applications, must be tested thoroughly for true compatibility with a new OS. And indeed,

Windows 95 is here, but many companies are approaching it with a wait-and-see attitude. For the hesitant, PC Labs tests 20 Windows 3.x corporate PCs.

By William P. Flanagan



many customized applications may not even run on Windows 95.

Companies must also factor in the cost of possible hardware upgrades, be it more memory, larger hard disks, or even completely new systems. (Microsoft claims that you need only 8MB of system memory to run Windows 95, but PC Labs' testing has shown that this new operating system is much happier and more productive with 16MB of RAM like Windows 3.x.) And then you must train your users to operate in this new environment. And don't forget the cost of employee downtime, which is inevitable during this process.

Taken together, all of these potential costs may run into tens of thousands of dollars for a large corporation. That's more than enough reason to stick with what works for a while longer. After all, if it ain't broke, why fix it?

It is for these cautious souls who prefer to stick with the status quo that we include in this issue a review of 20 network-ready, corporate workstations running Microsoft Windows 3.x and Microsoft Windows for Workgroups 3.11.

IN THIS REVIEW

Vendors of products reviewed:	IBM PC Direct	269
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REVIEW CRITERIA

This portion of our roundup focuses on network-ready, Pentium-powered computers running Windows 3.x, specifically targeted by vendors toward corporate buyers. To cover all the bases, we requested that vendors with multiple PC lines specifically targeted toward business users send representatives from each line. We invited only major vendors with distinct corporate lines to participate in this roundup.

Five companies sent representatives from multiple system lines, including Advanced Logic Research, AT&T Global Information Solutions, Compaq Com-

puter Corp., Dell Computer Co., and Digital Equipment Corp. Compaq sent three lines—the Deskpro, Deskpro XL, and ProLinea—but the others sent two.

We requested both high-end and midrange representatives from each line, although a few vendors opted to send only one system. High-end units were defined as those with a 120-MHz Pentium or faster processor. Midrange systems had to use either 90- or 100-MHz Pentium CPUs. Systems with Pentium-equivalent processors—including offerings from NexGen—were also acceptable, although we did not receive any systems for review that used them.

We saw seven Pentium/133 and four Pentium/120 PCs on the high end. For the midrange, we tested one Pentium/90 system and eight 100-MHz Pentium PCs. The lack of 90-MHz entries may indicate that vendors see corporate customers leaning toward 100-MHz systems as the new entry level of Pentium power, leaving the 75- and 90-MHz Pentium PCs only for the most cost-conscious of buyers.

Systems had to have exactly 16MB of RAM installed, 1GB or larger hard disks, 15-inch monitors, and graphics subsystems capable of supporting 1,024-by-768 resolution with 256 colors. In both categories, we required 16-bit sound capability, speakers, and minimum quad-speed CD-ROM drives (NEC and Micron both sent PCs with sextuple-speed drives). We also asked for machines with Ethernet adapters capable of

HIGHLIGHTS

Windows 3.x Pentium PCs

With Microsoft Windows 95 still largely untested and the costs of upgrading so high for many corporations, we expect a significant number of large businesses to hold off on the next step in Windows operating systems. The 20 network-ready corporate PCs we saw in this roundup offer a level of performance we've come to expect from Pentium PCs, because their hardware and software drivers are well tuned for the Windows 3.x environment.

WINDOWS 3.X BEATS Windows 95 in performance—at least for the time being. Winstone 96 scores posted by the systems tested in this section generally outpaced the scores of the Windows 95-equipped machines reviewed. This performance difference is because of tuning: Component vendors have not had time to tweak their offerings for maximum performance under Windows 95.

SYNCHRONOUS L2 CACHE continues to make a big difference in perfor-

mance, particularly on our CPUmark₁₆ tests. Systems with asynchronous cache—or no secondary processor cache at all, as seen in one of Gateway's entries—produce lower processor subsystem test scores, which in turn can dramatically affect other Windows-based test scores, especially Winstone.

THE IMPORTANCE OF DMI compliance is increasing, as vendors now are using this feature to distinguish their offerings from the competition. Although fewer than half of the systems here are DMI-compliant, and even fewer offer custom-built MIF browsers, this number is up significantly from our last Pentium roundup.

"RED CARPET" SUPPORT services are often available for large corporate accounts. Several vendors represented in this roundup offer corporate-only toll-free technical-support lines or even assign service technicians specifically to corporate accounts.

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CIRCLE 036 ON READER SERVICE CARD

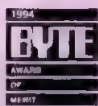
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CIRCLE 347 ON READER SERVICE CARD

handling at least 10-Mbps network connections.

One participant, Compaq, maintains that business-oriented PCs don't necessarily require sound. Therefore, Compaq's Deskpro and Pro-Linea systems reviewed here have no audio capabilities. The Deskpro XL line comes equipped with Compaq's 16-bit Business Audio.

WHO'S MISSING

Only a handful of the vendors we invited to participate in this roundup weren't able to supply us with machines in time to meet our deadlines. AST Research and ZEOS were in the midst of upgrading their lines. Unisys Corp. could not provide us with a machine in time for testing, and Acer America Corp. declined to participate.

As we were completing this story, AT&T announced its breakup. The new AT&T will be composed of three independent, publicly traded companies. The upshot of this deal is that AT&T is now out of the volume PC business: The company will no longer design and manufacture its own PCs—it will resell systems built by other vendors. We do review two AT&T Globalyst PCs in this roundup, as the units will be available through the middle of December.

DOES YOUR PC SPEAK DMI?

Many system vendors are distinguishing their corporate offerings by providing support for the Desktop Management Interface (DMI for short), a management system for PCs developed by the Desktop Management Task Force. DMI provides a bidirectional path to interrogate, define, and even update hardware and software components in a PC, allowing a DMI-compliant PC's components to be monitored from a central location on the network.

Granted, these functions can be (and

have been) performed by network management software packages such as Intel's LANdesk. But with DMI, the responsibility now lies with the system vendors to enable their machines to speak up and identify themselves over the network.

Of the machines reviewed here, only about half of them are DMI-compliant, including offerings from Dell, Digital, IBM, NEC, and ZDS. And only a few of those provide a MIF, or Management Information File, which holds system data such as model ID and serial number, that can be queried and updated over the network. We found NEC's offering to be one of the most comprehensive.

Although in its infancy, DMI will go a long way in eliminating at least part of the sneakernet activities of network adminis-

trators, by allowing them to perform hardware and software inventories or updates remotely.

ALL ROADS LEAD TO AN UPGRADE

For now Windows 3.1 is a widely available, proven platform for the corporate workstation. But network managers will not be able remain passive for long.

Logic dictates that companies will have to upgrade eventually, to either Windows 95, Windows NT, or an equivalent 32-bit platform. Sooner than you may think, 32-bit applications will push their 16-bit counterparts off store shelves, and the availability and support for 16-bit applications will slowly fade away. The 32-bit revolution is not only imminent, it's inevitable.

Midrange:

NEC PowerMate V100

Choosing corporate-level, network-ready workstations that suit your users, your IS department and your budget may appear to be an impossible task. Not only must they provide

enough computing horsepower for today and for the future, your new workstations should also be easily serviceable and budget conscious to boot.

Our midrange Editors' Choice is the \$2,849 NEC PowerMate V100 from NEC Technologies. One look at this 100-MHz Pentium computer and you'll know that it was built from the ground up to be a corporate-worthy system. Not only does the PowerMate come with a 3Com EtherLink III 10-Mbps Ethernet adapter installed, but it also includes preloaded client software for NetWare, Microsoft Windows for Workgroups, and Microsoft Windows NT. This system is also DMI-compliant and includes a comprehensive, 160-attribute MIF (Management Information File) browser.

The PowerMate also casts an eye toward a future that includes computer-based training, teleconferencing, and animated presentations. This machine is outfitted with an impressive graphics subsystem that supports full-screen, full-motion video, MPEG playback, and colorspace conversion; it also comes with Intel's ProShare software.

High end:

Digital Celebris GL 5120st

Our Editors' Choice selection on the high end is the \$4,273 Digital Celebris GL 5120st. This Pentium/120-based PC should please its target audience of corporate power users:

Not only was it the top performer in its own CPU class, but some of its benchmark test scores neared those of 133-MHz Pentium PCs tested as well.

The DMI-compliant Celebris GL 5120st is also highly integrated: It features on-board 16-bit audio, an Ethernet controller, and built-in SCSI support, as well as cutting-edge graphics driven by a Matrox graphics engine backed by 2MB of Window RAM. This graphics engine supports 2-D and 3-D graphics and video acceleration. Its case has large thumbscrews, making service calls a snap.

We also found two systems from Micron worthy of Honorable Mention: the 100-MHz Pentium \$3,346 P100 Millennia and the 133-MHz Pentium \$3,896 P133 Millennia. If you're looking for top performance at either processor level but can live without such extras as three-year warranties and DMI compliance, Micron's machines are solid choices.



Price/Performance Index: Windows 3.x Pentium PCs

Our two Editors' Choices prove you can get a great package even if you don't choose the fastest CPU available. The NEC PowerMate V100 leads the pack on the price/performance scale. Priced to move at \$2,849, the Pentium/100-based PowerMate was a steady performer on our tests. Its extras make it really stand out: It includes a 6X CD-ROM drive and a graphics subsystem that supports full-screen, full-motion video and MPEG playback.

The \$4,273 Digital Celebris GL 5120st may be more expensive than other PCs reviewed, but it packs a lot of bang for your buck. It had terrific scores on all Windows-based performance tests. The unit's motherboard features on-board Ethernet and cutting-edge graphics in the form of Matrox's new RAM-backed graphics engine, which supports 2-D and 3-D graphics and accelerated video.—
Analysis written by Mary E. Behr

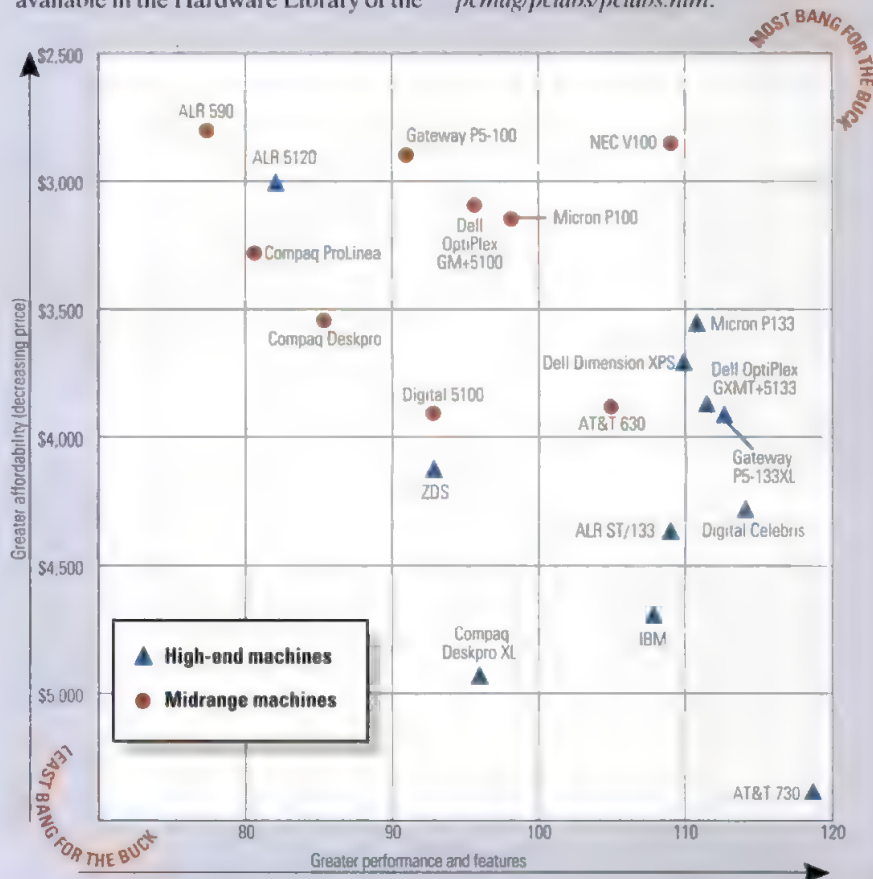
THE DATA POINTS

Scores on our benchmark tests, particularly the Winstone 96 test, account for just under half of the total price/performance score. Warranty terms, technical support, and ratings from our Service and Reliability survey account for almost 10 percent. Features, com-

ponents, and expandability make up the remainder of the score.

Price/performance index data is available in the Hardware Library of the

Editorial Forum on PC MagNet under 21BANG2.TXT and on the World-Wide Web at <http://www.ziff.com/~pcmag/pclabs/pclabs.htm>.



Advanced Logic Research Inc. Evolution V ST/133, Optima 590, Optima 5120

Both Advanced Logic Research's Evolution and Optima lines hit their target markets in most areas. The Optimas hit the price point for the mainstream corporate market, and the Evolution V offers top performance for corporate power users. We tested one Evolution, the \$4,357 Evolution V ST133, and two Optimas, the \$2,799 Optima 590 and the \$2,999 Optima 5120 (all prices are street prices).

All three PCs came with an optional \$156 Cogent EM960 Ethernet PCI adapter; it has AUI, BNC, and RJ-45 connec-

tors. No Token-Ring option is available, but a 100-Mbps Cogent EM110 Ethernet card is a \$240 option.

The Evolution V ST133 mini-tower PC is loaded with 256K pipelined-burst L2 cache, a 1.5GB EIDE hard disk, and a Diamond Stealth 64 Video VRAM graphics card with an S3 Vision968 chip set and 2MB of VRAM. These components combined are hard to beat: This unit had the top Graphics WinMark 96 score for its CPU class and its Winstone 96 and Disk WinMark 96 scores were in the top five for its class.

The slimline case of the Optima systems offers one PCI

and two ISA slots, limiting the expansion room. Some space is conserved by integrating a 32-bit S3 Trio32 graphics chip set with 2MB of DRAM onto the motherboard. The other components are also less impressive than the ones in the Evolution V: Their slower graphics subsystems are combined with 256K of asynchronous L2 cache, Vibra 16 sound cards, and 1GB EIDE hard disks.

There were four systems in the Pentium/120 class. The Optima 5120's Disk WinMark scores were comparable to those of most of the other units in this class. But its 32-bit graphics subsystem could not keep up with

IN SHORT
Both lines are decent choices for their markets, but they were not strong performers.

SERVICE & RELIABILITY

Advanced Logic Research Inc.

Reliability	Average
Repair	Average
Technical support	Average
Percent needing repair	Better than average



← S P E E D →



← H D D C A P A C I T Y →



← W A R R A N T Y →



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Battery
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SAMSUNG SENS 800 - \$2,999

75 MHZ Pentium, 10.4" Active Matrix color, 810MB HDD, 8MB RAM

Removable HDD: 520, 810MB, 1.3GB • Windows '95 installed • Internal 3.5" floppy disk drive • Infrared Data Transfer • 3 year warranty • Two PCMCIA Slots. (can be used simultaneously) • Built-in ergonomic track ball • Sparkling 10.4" Dual Scan color or 10.4" Active Matrix color; 1 MB video RAM; simultaneous LCD/CRT display • AC voltage adapter, spare NiMH battery included free • Full business audio with built-in mic. & speaker • Only 11.3"x 8.9"x 2.1" and 6.2 lbs (Dual Scan color) • Free carrying case

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SENS 800, 75 MHZ Pentium,
10.4" Dual Scan color, 520MB
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the 64-bit competition, lowering its Graphics WinMark and Winstone scores. A slower memory subsystem also hindered performance.

The Optima 590 was the only Pentium/90 PC in this roundup. Its Disk WinMark performance was on a par with that of average 90-MHz systems. Its graphics performance and Winstone scores, however, were not good. This unit had the same graphics and memory subsystem that hobbled the Optima 5120.



All three units have a five-year parts, three-year labor warranty.

One year of on-site service is \$9.95.—
William P. Flanagan

Advanced Logic Research Inc., Irvine, CA;
800-444-4257, 714-581-6770; fax 714-581-9240.

Circle 465 on reader service card

AT&T Global Information Solutions

Globalyst 630, Globalyst 730

The \$3,880 AT&T Globalyst 630 and the \$5,380 AT&T Globalyst 730 both kept pace with their competitors on our benchmark tests, and both feature unique designs. The Globalyst 730's price may seem high, but it includes a 17-inch monitor as well as a whopping 1MB of synchronous level-2 processor cache.

Can't decide between a mini-tower or a desktop PC? With the Globalysts, you don't have to commit: both have removable front-access drive cages, which can be repositioned for either footprint.

The Globalysts' motherboards employ a riser-card design which holds the expansion slots. Both feature integrated S3 graphics accelerator chip sets—the Trio64 for the 630 and the Vision968 for the 730. Both also came with SMC Ethernet adapters with 10Base-T and 10Base2 connectors (a \$300 Token-Ring card is available).

The Globalyst 730 is one of the most highly integrated systems in this roundup. In addition to graphics, it features on-board 16-bit audio, as well as a second CPU socket and a SCSI port. A large array of communications software is also

included, with titles such as Vistium Share and AT&T Mail Flash.

The 730 posted average scores on our Graphics WinMark 96, Winstone 96, and Disk WinMark 96 tests compared with the other 133-MHz PCs.

The Globalyst 630 features a PC Card drive with slots for one Type III or two Type II devices—a unique feature in this roundup. Our benchmark tests showed the 630 to be on a par with the 100-MHz Pentium group on our Winstone and Graphics WinMark tests, and above the average on our Disk WinMark tests.

The warranty on each machine is three years, which covers parts, labor, and one year of on-site service. Buyers may want to think twice, however: AT&T will honor warranties but will no longer be manufacturing or selling its own PCs.—*WPF*
AT&T Global Information Solutions,
Dayton, OH; 800-447-1124, 513-445-5000.

Circle 466 on reader service card

Compaq Computer Corp.

ProLinea 5100, Deskpro 5100, Deskpro XL 5120

What distinguishes Compaq Computer Corp.'s Deskpro line from the competition is the vendor's "Intelligent Manageability" features, which include software that allows local monitoring and inventory of hardware, as well as remote management of networked stations with the addition of third-party software (under Windows 95, remote management is supported). New ProLineas also offer some of these capabilities. The three Compaq units we review here are built exceptionally well, though none are stellar performers.

The \$3,358 ProLinea 5100 Model



IN SHORT

Both Globalyst systems from AT&T feature a well-thought-out design and average performance.

SERVICE & RELIABILITY

AT&T GIS

Reliability	Worse than average
Repair	Average
Technical support	Average
Percent needing repair	Average

1080/w value PC targets the mainstream business or small office/home office market and features a unique, easy-access case design. The \$3,542 Deskpro 5100 Model 1080/w, aimed at networked corporate users, has the same case and adds integrated Ethernet. And the \$4,924 Deskpro XL 5120 Model 1050/w is positioned as a power-user system and features on-board Ethernet and 16-bit sound. (All prices are street prices.)

The ProLinea 5100's mini-tower case design makes component management simple. Removing one side panel provides access to the memory banks and the CPU. The other side panel reveals the unit's expansion slots. The top section of the machine covers the system's five drive bays.

Network connections for the ProLinea 5100 were handled by Compaq's NetFlex-3/E Ethernet card (with RJ-45 and AUI ports), a \$215 option included in the above price. Token-Ring (\$89), 100BaseTX UTP (\$117), and 100 VG-AnyLAN UTP (\$117) cards are available for all three PCs.

On our tests the ProLinea 5100 equipped with Windows 3.1 couldn't keep pace with its Windows for Workgroups-powered competition. The system's Disk WinMark 96, Winstone 96, and Graphics WinMark 96 scores were all below its CPU group's averages.

The Deskpro 5100 comes in the same case as the ProLinea, but its motherboard features an on-board NetFlex/3 Ethernet

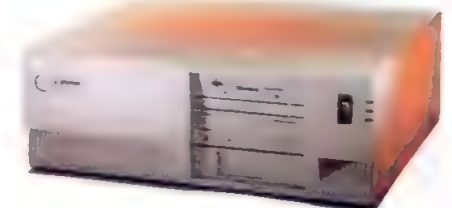
IN SHORT

The three entries from Compaq are built exceptionally well, but aren't stellar performers.

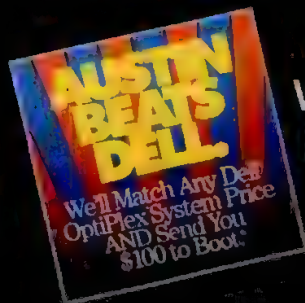
SERVICE & RELIABILITY

Compaq Computer Corp.

Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Better than average



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- Weight with Battery: 5.5 lbs.
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* Limited time offer. Written quote from Dell must be provided. \$100 Cash Back offer applies to purchase of Austin PowerPLUS 100, 120 and 133 only. Call for details.

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Integrated Pointing Device
2 Type II or 1 Type III PCMCIA Slots
Parallel, Serial, Keyboard, IRDA, SVGA Ports
Lithium Ion Battery
Weight with Battery: 5.5 lbs.
One-Year Parts & Labor Warranty
Win '95 Plug n' Play BIOS
MS Office 95 Standard
Windows 95 Pre-Installed

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- 75MHz Intel Pentium Processor
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September, 1995



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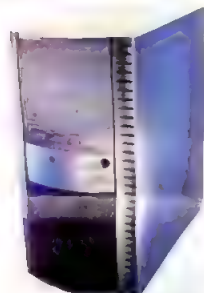
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William P. Flanagan

Advanced Logic Research Inc., Irvine, CA;
800-444-4257, 714-581-6770; fax 714-581-9240.

Circle 465 on reader service card

AT&T Global Information Solutions

Globalyst 630, Globalyst 730

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AT&T Global Information Solutions,
Dayton, OH; 800-447-1124, 513-445-5000.

Circle 466 on reader service card

Compaq Computer Corp.

ProLinea 5100, Deskpro 5100, Deskpro XL 5120

What distinguishes Compaq Computer Corp.'s Deskpro line from the competition is the vendor's "Intelligent Manageability" features, which include software that allows local monitoring and inventory of hardware, as well as remote management of networked stations with the addition of third-party software (under Windows 95, remote management is supported). New ProLineas also offer some of these capabilities. The three Compaq units we review here are built exceptionally well, though none are stellar performers.

The \$3,358 ProLinea 5100 Model



IN SHORT

Both Globalyst systems from AT&T feature a well-thought-out design and average performance.

SERVICE & RELIABILITY

AT&T GIS

Reliability	Worse than average
Repair	Average
Technical support	Average
Percent needing repair	Average

1080/w value PC targets the mainstream business or small office/home office market and features a unique, easy-access case design. The \$3,542 Deskpro 5100 Model 1080/w, aimed at networked corporate users, has the same case and adds integrated Ethernet. And the \$4,924 Deskpro XL 5120 Model 1050/w is positioned as a power-user system and features on-board Ethernet and 16-bit sound. (All prices are street prices.)

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Network connections for the Prolinea 5100 were handled by Compaq's NetFlex-3/E Ethernet card (with RJ-45 and AUI ports), a \$215 option included in the above price. Token-Ring (\$89), 100BaseTX UTP (\$117), and 100 VG-AnyLAN UTP (\$117) cards are available for all three PCs.

On our tests the ProLinea 5100 equipped with Windows 3.1 couldn't keep pace with its Windows for Workgroups-powered competition. The system's Disk WinMark 96, Winstone 96, and Graphics WinMark 96 scores were all below its CPU group's averages.

The Deskpro 5100 comes in the same case as the ProLinea, but its motherboard features an on-board NetFlex/3 Ethernet controller, with RJ-45 and AUI connectors. An integrated QVision 1280/P accelerator handles graphics functions.

This Compaq graphics accelerator helped the Deskpro 5100 achieve its best test result, an average score on our Graphics WinMark test. Its other test scores were below

IN SHORT

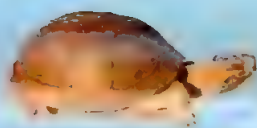
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SERVICE & RELIABILITY

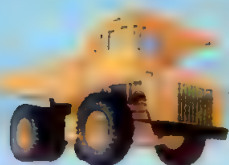
Compaq Computer Corp.

Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Better than average

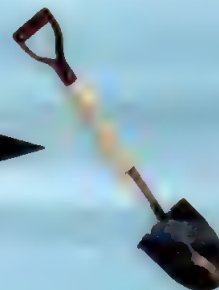




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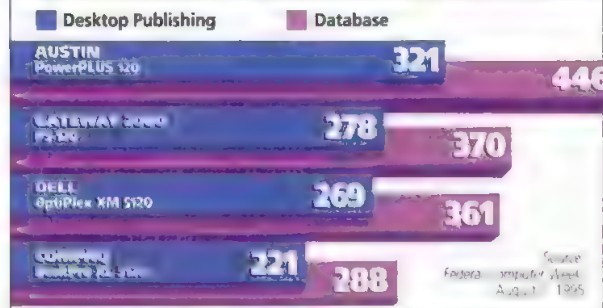
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SYSmark/Win Benchmark Results



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Internal 3.5" Diskette Drive
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Parallel, Serial, Keyboard, IRDA, SVGA Ports
Weight with Battery: 5.5 lbs.
One-Year Parts & Labor Warranty
Win '95 Plug n' Play BIOS
MS Office 95 Standard
Windows 95 Pre-Installed

BUSINESS AUDIO XL 486DX4-75 \$2,349

- 75MHz Intel 486 DX4 Processor
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External Jacks for Line-In/Line-Out
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Integrated Pointing Device
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Parallel, Serial, Keyboard, SVGA Ports
Weight with Battery: 6.5 lbs.
One-Year Parts & Labor Warranty
MS Office 95 Standard
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Benchmark Tests: Windows 3.x PCs

average for its CPU group.

The high-end, EISA/PCI-based Deskpro XL offers integrated sound, graphics, and Ethernet, as well as an external SCSI port. However, only one drive bay was available in our test configuration.

The Deskpro XL was a fairly good performer. Its Disk WinMark score was below average (because of Windows 3.1's lack of a 32-bit disk cache) but its Graphics WinMark and Winstone scores were average for its Pentium/120 group.

Compaq sells the ProLinea and Deskpro lines without audio, and the Deskpro XL line only comes with a 16-bit integrated sound chip. This limitation set these units apart from other PCs reviewed, but Compaq claims its average business client does not require sound.

All three lines are backed with a three-year warranty, with one year of on-site service included (response by the end of the second business day). Two additional years of on-site service cost \$99.—*WPF*
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Circle 467 on reader service card

Dell Computer Corp.

Dimension XPS P133c, OptiPlex GM+ 5100, OptiPlex GXMT+ 5133

Whether you need a system specifically for the home office or for a large corporation of networked employees, Dell has a unit that will suit your needs. Dell submitted one PC from the Dimension line, the \$3,698 Dimension XPS P133c, and two systems from the OptiPlex line, the \$3,092 OptiPlex GM+ 5100 and the \$3,864 GXMT+ 5133 (all prices are street prices).

IN SHORT

All three of Dell's PCs are competitive performers, backed by great warranties.

SERVICE & RELIABILITY

Dell Computer Corp.

Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Average

Dell's Dimension line is aimed at small office/home office buyers and home power-users. This mini-tower system distinguished itself from the pack with some great components, including a 17-inch monitor (complemented by a Number Nine Imag-

What the Numbers Mean

Our corporate systems running Windows 3.x show their strength when running today's 16-bit applications. On the average, they posted higher scores on our Disk WinMark 96, CPUmark₁₆, and Winstone 96 tests than their Windows 95 counterparts (reviewed earlier in this story). Ultrafast hard disks, 64-bit graphics cards, and advanced memory subsystems were common in the systems we reviewed, regardless of operating system.

WINSTONE 96

On our Winstone 96 tests, top-performing processor, disk, and graphics subsystems contributed to big scores. Enhanced IDE hard disks spinning at 5,000 rpm or faster gave the top Winstone performers a boost. And 64-bit graphics cards like the Diamond Stealth 64 Video VRAM and the Matrox Millennium helped graphics subsystems to perform their best.

At the top of the Winstone charts were three Pentium/133 systems that finished in a virtual tie: Micron's P133 Millennia, Dell's Dimension XPS P133c, and ALR's Evolution V ST/133. All of these machines are powered by Intel's Triton chip set and 256K of synchronous or pipeline-burst cache.

Opting against Windows for Workgroups can cause system performance to drop by as much as 65 percent, as seen in the performance of Compaq's ProLinea 5100 (which used Windows 3.1). Compaq's Deskpro 5100 also used Windows 3.1, and its performance suffered by 45 percent.

GRAPHICS WINMARK 96

The Diamond Stealth 64 Video VRAM and the Matrox Millennium graphics cards continue to dominate, even on our new benchmarks. The Diamond Stealth 64 Video VRAM powered two of the top finishers on our Graphics WinMark 96 tests, the Micron P100 Millennia and the ALR Evolution V ST/133.

The choice of a 32-bit graphics engine in both ALR Optima PCs sealed their fates as last-place finishers. Both Optimas used an integrated S3 Trio32 chip set. Today's Pentium/PCI systems have plenty of bandwidth to take advantage of 64-bit graphics chip sets.

DISK WINMARK 96

It was no surprise that the top Disk WinMark 96 scores went to PCs that used the fastest-spinning hard disks with the lowest drive latencies. The Quantum Fireball 1080A, the Western Digital 31600H, and the Conner CFA 1275A all

have rotational speeds above 5,000 rpm.

The two top Disk WinMark scores were posted by the Dell Dimension XPS P133c and the IBM PC 300, both of which used Quantum's Fireball hard disk. In fact, the only Fireball-equipped system that was bested by the competition was NEC's PowerMate V100. It just missed a top score because the vendor disabled Windows for Workgroups' 32-bit disk access.

CPUMARK₁₆

The CPUmark₁₆ test showed two trends: the use of synchronous cache—whether pipelined burst or not—and the amount of L2 cache installed both have dramatic effects on CPU scores.

The Pentium/133-based AT&T Globalyst 730 packed a whopping 1MB of synchronous L2 cache to power it to one of the highest CPUmark₁₆ scores in this review. But this extra SRAM contributed to the Globalyst 730's \$5,380 price tag, the highest in this roundup of corporate PCs.

At the other end of the cache spectrum was the Gateway P5-100 PC. The vendor chose not to install any L2 cache in this machine, and its CPU score suffered dramatically as a result.

CD-ROM AND MULTIMEDIA TESTS

PC Magazine's new CD-ROM and multimedia tests measure the performance of the entire CD-ROM subsystem, which includes the CD-ROM drive, its adapter, and its software drivers.

CD-ROM WINMARK 96

The CD-ROM WinMark 96 test exercises the CD-ROM drive by simulating operations from six Windows CD-ROM applications.

Not surprisingly, the speediest CD-ROM drives helped to produce the highest CD-ROM WinMark scores. The two top-scoring PCs on this test—the NEC PowerMate V100 and the Micron P133 Millennia—both used sextuple-speed (6X) drives: the NEC CDR-502 CD-ROM drive and the Plextor PX-63CS CD-ROM drive, respectively.

CD-ROM SEQUENTIAL 16K READ

The sequential read test performs 16K block-size sequential reads from the CD-ROM drive. Scores should come close to the rated speed of the CD-ROM drive. For instance, a double-speed CD-ROM drive should have a transfer rate of about 300 KBps, a quadruple-speed CD-ROM drive should have a transfer rate around 600 kilobytes per second, and so forth. All CD-ROM drives' tested transfer rates matched their claimed rates.

ACCESS TIME

The CD-ROM Access Time test performs random accesses on the CD-ROM and then reports the average access time in milliseconds. Each access is a 2K read from a random sector on the CD-ROM. The CD-ROM Access Time test uses MSCDEX reads and uses the entire CD-ROM. The average stroke distance is one-third of the CD-ROM image.

You should note that the CD-ROM Access Time scores may be slightly higher than figures CD-ROM manufacturers report. (That is, this test may report the drive as being slower than the manufacturer's claim.) This difference occurs because (1) WinBench 96 performs a seek and a 2K read, whereas the CD-ROM manufacturers report only the time it takes to seek to the data; (2) WinBench 96 uses software drivers to access the CD-ROM drive, whereas some CD-ROM manufacturers may use specialized hardware to time the seeks; (3) WinBench 96 may use a longer average stroke distance than the CD-ROM manufacturers.

Access times posted by these CD-ROM drives were no surprise. The 6X CD-ROM drive in the Micron Millennia P133 turned in the lowest (best) access time. The best-scoring quadruple-speed CD-ROM drives were the Sanyo CRD-254P in the Micron P100 Millennia and the Toshiba XM-5302TA in the ZDS Z-Station GT.

CD-ROM CPU UTILIZATION

CD-ROM CPU Utilization is a measure of the percentage of the processor's bandwidth occupied by servicing the CD-ROM subsystem. For example, if WinBench 96 calculates your PC's CD-ROM CPU Utilization to be 35 percent, then the CPU spends

35 percent of its resources reading data from the CD-ROM subsystem, leaving 65 percent of its resources to do something with the data it's reading (such as displaying that data on the monitor in the form of video).

To determine CPU Utilization, WinBench 96 uses a default block size of 16K. The transfer rate defaults to the maximum transfer rate of your CD-ROM drive. WinBench 96 then calculates this transfer rate before it runs the test. This means that CD-ROM CPU Utilization results cannot be compared across different-speed CD-ROM drives.

The higher the CD-ROM drive's transfer rate, the less time it needs to transfer a block of data. But with this decreased block-transfer time comes increased CPU Utilization. For instance, a 6X drive will transfer a set amount of data in less time than a quad-speed drive, so the CPU has more data available to read from the CD-ROM drive and can spend more time accessing the CD-ROM subsystem, giving a higher CPU Utilization score than a quad-speed drive. But processing should still be accelerated with the 6X drive, because less time overall is spent servicing CD transfers. If this were not the case, then no one would benefit from a faster drive.

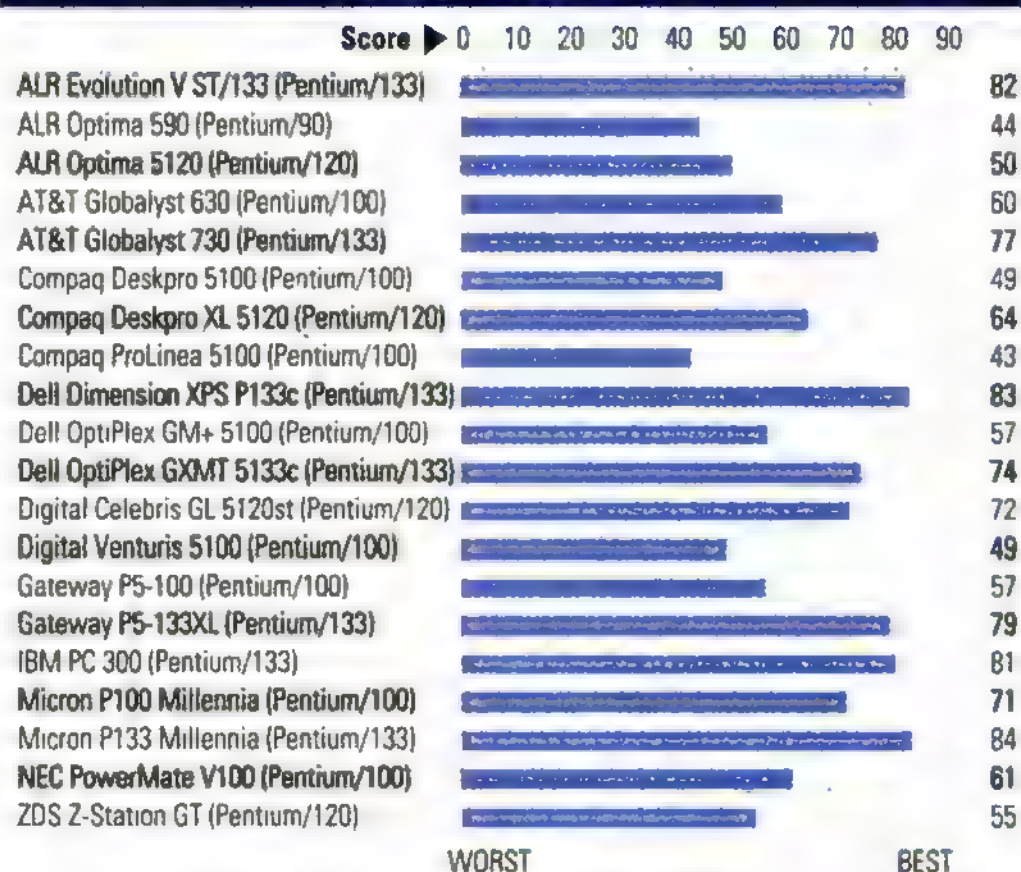
VIDEO DATA RATE AND SCALING

To test video playback we used three .AVI files: two using the Indeo codec, and the other using the Cinepak codec. Since all systems run the clip at the same transfer rate, you can compare the scores of systems with identical CD-ROM drives within CPU categories.

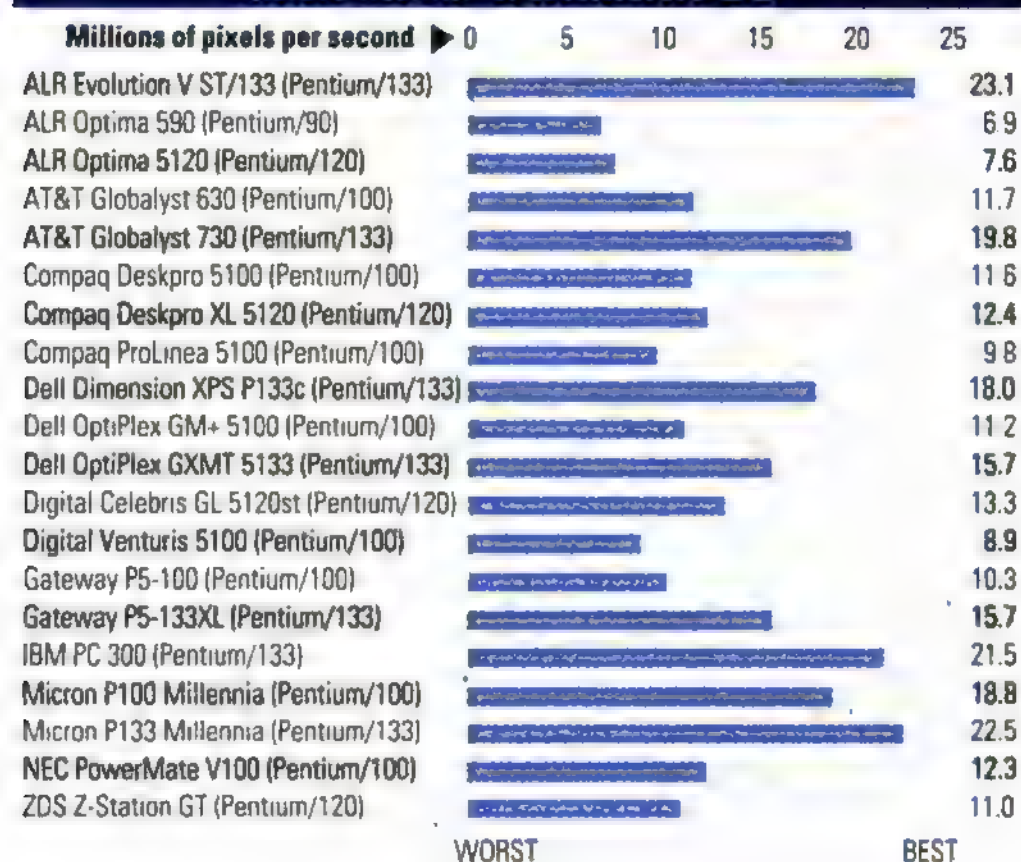
The NEC PowerMate V100 was the best performer. Its combination of an Alliance ProMotion 6422 graphics controller and an NEC 6X CD-ROM drive dropped virtually no frames in any of these tests. The Alliance ProMotion controller, using an MMU1 accelerator, has built-in video acceleration. It supports interpolated video scaling and on-the-fly colorspace conversion. (For details on our testing procedures, see the sidebar "How We Tested").

—Analysis written by Richard Fisco

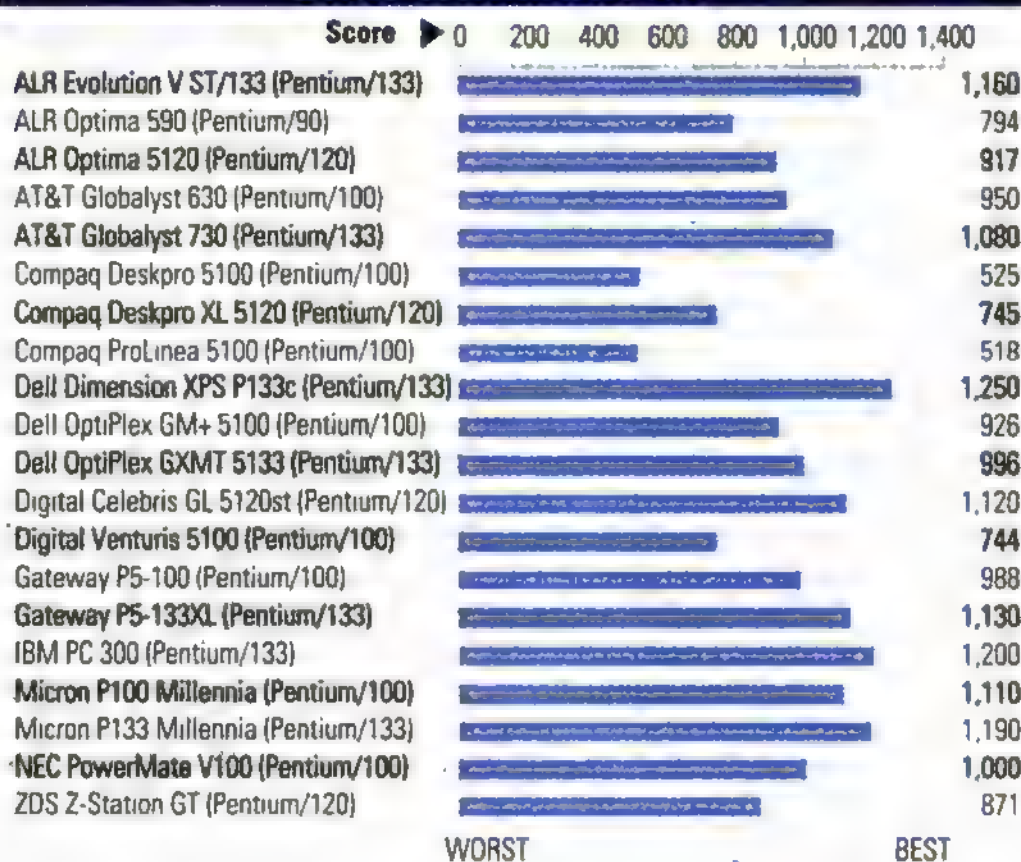
WINSTONE 96



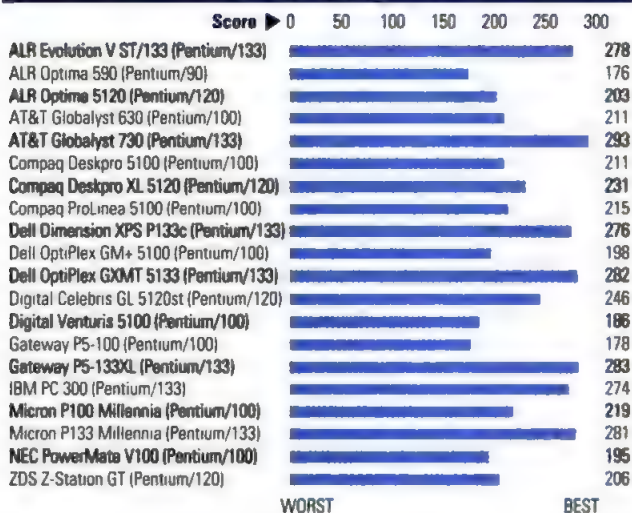
GRAPHICS WINMARK 96



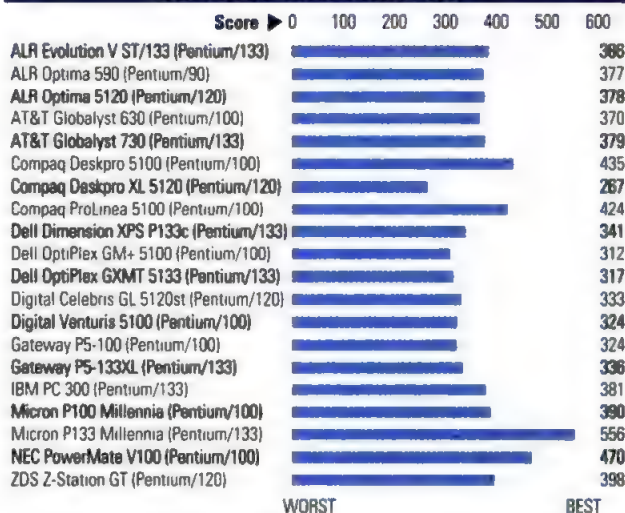
DISK WINMARK 96



CPUMARK₁₆



CD-ROM WINMARK 96



▲ Higher scores represent better performance.
▼ Lower scores represent better performance.

	WINSTONE 96				CD-ROM			VIDEO DATA RATE ¹		FULL-SCREEN VIDEO SCALE ²		VIDEO MATRIX ³	
	Spread-sheet ▲	Word Processing ▲	Database ▲	Business Graphics/DTP ▲	Sequential 16K Read ▲	Access Time (ms) ▼	CPU Utilization ▼	Frames Dropped ▼	CPU Utilization ▼	Frames Dropped ▼	CPU Utilization ▼	Frames Dropped ▼	CPU Utilization ▼
ALR Evolution V ST/133 (P/133)	8.0	8.1	8.7	8.3	613 KBps	248	55%	3	91%	5	98%	6	71%
ALR Optima 590 (P/90)	4.0	4.3	4.9	4.9	613 KBps	259	57%	185	93%	187	99%	4	43%
ALR Optima 5120 (P/120)	4.5	5.0	5.8	5.4	614 KBps	254	56%	152	99%	364	92%	4	42%
AT&T Globalyst 630 (P/100)	5.7	5.7	6.5	6.1	613 KBps	235	66%	78	85%	407	78%	0	93%
AT&T Globalyst 730 (P/133)	7.4	7.7	7.9	7.9	614 KBps	237	43%	78	86%	374	80%	4	52%
Compaq Deskpro 5100 (P/100)	4.4	5.0	5.0	5.2	911 KBps	230	63%	154	81%	340	79%	0	45%
Compaq Deskpro XL 5120 (P/120)	6.1	6.5	6.9	6.3	614 KBps	349	29%	156	87%	232	96%	0	50%
Compaq ProLinea 5100 (P/100)	3.6	4.2	4.7	5.0	917 KBps	239	62%	0	83%	328	31%	0	57%
Dell Dimension XPS P133c (P/133)	8.0	8.2	8.9	8.2	612 KBps	602	41%	105	93%	343	91%	4	36%
Dell OptiPlex GM+ 5100 (P/100)	5.5	5.5	6.1	5.9	614 KBps	272	51%	48	71%	340	82%	4	46%
Dell OptiPlex GXMT 5133 (P/133)	7.1	7.1	7.9	7.6	614 KBps	273	48%	77	82%	12	36%	4	31%
Digital Celebris GL 5120st (P/120)	7.0	7.3	7.5	7.0	613 KBps	301	63%	173	99%	278	97%	0	44%
Digital Venturis 5100 (P/100)	4.5	4.8	5.3	5.4	613 KBps	307	73%	106	91%	387	88%	5	51%
Gateway P5-100 (P/100)	5.6	5.6	5.8	5.5	611 KBps	311	55%	63	82%	243	95%	4	42%
Gateway P5-133XL (P/133)	7.9	7.9	8.2	7.7	613 KBps	314	53%	49	73%	187	98%	4	37%
IBM PC 300 (P/133)	7.7	7.9	8.4	8.4	612 KBps	245	41%	68	62%	259	94%	2	28%
Micron P100 Millennium (P/100)	6.9	6.9	7.8	7.2	613 KBps	221	54%	0	82%	9	99%	6	67%
Micron P133 Millennium (P/133)	8.0	8.3	8.8	8.5	614 KBps	163	58%	42	61%	340	79%	6	77%
NEC PowerMate V100 (P/100)	5.8	6.1	6.8	6.1	307 KBps	224	63%	373	97%	304	96%	0	43%
ZDS Z-Station GT (P/120)	5.2	5.3	5.8	5.8	613 KBps	203	82%	0	95%	328	99%	2	48%

1 With an Action, Indeo, 320 x 240, 30-fps, 600-KBps clip 2 With an Action, Indeo, 160 x 120, 30-fps, 300-KBps clip 3 With an Action, Cinepak, 320 x 240, 30-fps, 300-KBps clip

ine 128 graphics card with 4MB of VRAM) and a 28.8-/14.4-Kbps data/fax modem. The unit also included a 3Com Etherlink III PCI network card with AUI, BNC, DIX, and RJ-45 connectors.

The Dimension was a strong performer on our benchmark tests. A Quantum Fireball 1GB hard disk helped the unit to post the best Disk WinMark 96 score of the Pentium/133 group. Its Winstone 96 and Graphics



WinMark 96 scores were both on a par with the competition.

The 100-MHz Pentium-powered OptiPlex GM+ 5100 desktop PC is aimed at mainstream corporate buyers. This DMI-compliant system's Dell motherboard employs a riser-card design, and integrates video (with S3's Trio64 graphics chip set) and an Ethernet connector (driven by 3Com's EtherLink III chip set), but to

physically access the machine's memory banks, you first have to remove a cross-beam. The GM+ 5100 posted average Disk WinMark, Graphics WinMark, and Winstone test scores for its CPU group.

The OptiPlex GXMT+ 5133 is a representative of Dell's new DMI-compliant OptiPlex GX line for corporate buyers. This 133-MHz Pentium mini-tower system's motherboard, like its OptiPlex cousin, features integrated video and Ethernet. But this machine uses S3's new Trio64+ graphics chip set, which supports

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Canon

Windows 3.x PCs

hardware-assisted video playback, software MPEG-1, and colorspace conversion. Dell also includes a 17-inch monitor.

On our tests, the GXMT+ 5133 posted an average Winstone score. Its Disk WinMark and Graphics WinMark scores were below its CPU group's averages.

All three PCs are backed by a three-year parts, one-year labor warranty, with one year of on-site service, and 24-hour, 7-day technical support.—WPF

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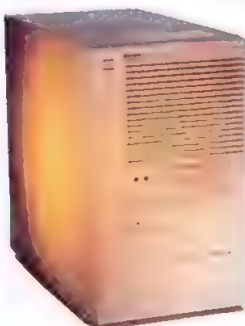
Venturis 5100, Celebris GL 5120st



Digital Equipment Corp. has designed two DMI-compliant PC lines with different goals: Celebris systems target corporate power users, while Venturis PCs aim for general business users. The \$4,273 Celebris GL 5120st, one of our Editors' Choice selections, should serve its audience well: It offers an innovative and easily serviceable design, and performed at the top of its class on our tests. The \$3,906 Venturis 5100, however, suffered from poor performance and a small case design with limited expansion potential.

The Celebris GL 5120st is housed in what Digital calls a "short tower" case. This case features big, easy-to-turn thumbscrews for painless system access. The Celebris uses a riser card design found in many slim-line PCs, but to better effect. This Pentium/120 system's motherboard provides 16-bit sound, an Ethernet controller, and integrated high-end video (a Matrox 2064w chip set with 2MB of Window RAM) that supports 2-D and 3-D graphics and video acceleration. So all slots are available on the riser card, which also features built-in SCSI support.

The Celebris' Windows-based test scores



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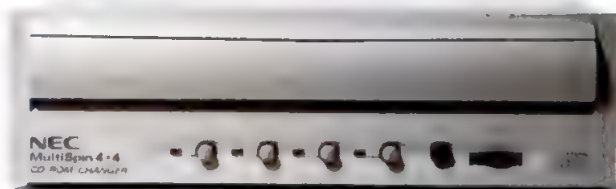
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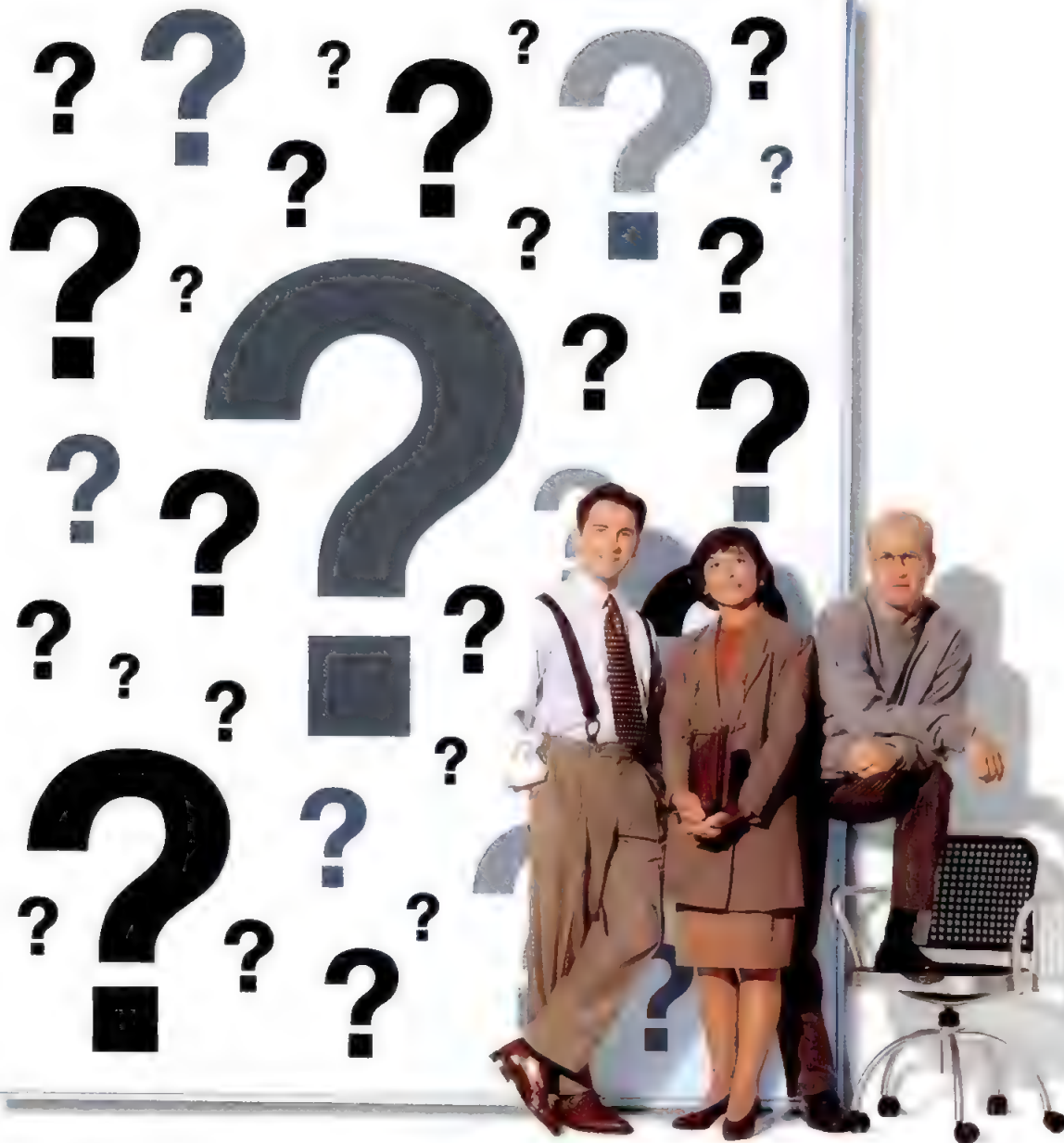
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now, thanks to the MultiSpin 4x4, if you've got the space for one CD, you've got the space for four.

For information via FastFacts™ call 1-800-360-0476 and request document #237492. Contact us on the Internet at <http://www.nec.com>. MultiSpin is a registered trademark and FastFacts, 4x4 and See, I Hear and Feel the Difference are trademarks of NEC Technologies, Inc. All other trademarks are the property of their respective owners. ©1995 NEC Technologies, Inc. GSA#GS00K94AG85241PS01 Key #62912

CIRCLE 153 ON READER SERVICE CARD



The new HP LaserJet 5Si MX network printer answers your users' questions so you won't have to.

Don't spend your day fielding questions about network printers. Instead,



take a look at the HP LaserJet 5Si MX. With enhanced user software, inquiries such as "Is the printer out of toner? Out of paper?" or "Is it busy with another job?" all get answered immediately. Right from your users' desktops. Any print job—from the very simple to the very complex—can be tracked, managed, cancelled, or sent to a different

printer quickly and easily. And the best thing is that you'll never hear about it. So take the intelligently simple approach to network printing. It may just free enough of your time for other important matters, starting with lunch.

HP Network Printers
Just what you had in mind.

IN SHORT

Power users will love the Celebris; the Venturis is priced right but may leave many users wanting more space.

SERVICE & RELIABILITY

Digital Equipment Corp.

Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Better than average

were all at the top of its class. Its performance on our Disk WinMark 96 test even rivaled that of some of the Pentium/133 PCs in this roundup.

The slim line Venturis 5100 uses a riser card design with only three expansion slots; two in our test unit were used by an Ethernet

card and a sound card. The unit also only has only two SIMM slots, which limits memory upgrades. Video is integrated in the form of an S3 Trio64 chip set.

The Venturis posted below-average scores on all Windows-based tests. Its performance was hobbled by its SiS core-logic chip set, asynchronous L2 cache, and standard DRAM.

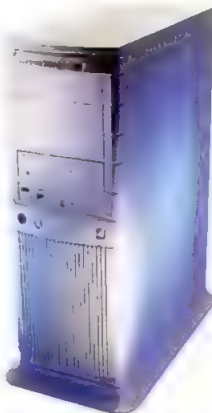
Both PCs have a three-year warranty with one year of on-site service.—WPF
Digital Equipment Corp., Acton, MA; 800-344-4825, 508-624-6400; fax, 800-652-4532.
Circle 469 on reader service card

Gateway 2000 Inc.

P5-100,
P5-133XL

The \$3,906 P5-133XL tower and the \$2,896 P5-100 desktop from Gateway 2000 not only came with the best software bundles in this roundup, they also offer users fair performance at a reasonable price. These Windows 3.x Pentium PCs are targeted at businesses and power users.

Both systems used Intel Triton-based motherboards, EDO DRAM, and a PCI-based Matrox Millennium graphics accel-



IN SHORT

These reasonably priced systems offer fair performance and a great software bundle.

SERVICE & RELIABILITY

Gateway 2000 Inc.

Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Average

SUMMARY OF FEATURES

Windows 3.x Pentium PCs

Price of tested configuration For each machine, we quote the vendor's price for the entire system as tested by PC Labs, including the monitor and any other options installed by the vendor, such as modems, network cards, and any bundled software.

Processor Numeric suffixes to the Pentium name indicate clock speeds in megahertz.

Installed RAM Some machines use EDO (extended data out) DRAM, which can marginally boost performance over standard fast-page mode DRAM.

Hard disk capacity and interface EIDE denotes Enhanced IDE, an extension to IDE that supports faster transfer rates, higher disk capacities, and mass-storage devices other than hard disks. Fast ATA-2 denotes Seagate's EIDE-like specification for increased transfer rates and larger capacities.

Graphics adapter (and memory type) VRAM and the new WRAM (Window RAM—not associated

with Microsoft Windows) graphics memory types are faster than DRAM because both can move data in and out simultaneously.

CD-ROM drive interface ATAPI is a specification that enables CD-ROM drives to act much like hard disks, which allows them to be connected to Enhanced IDE interfaces. Proprietary drives connect to a special connector on a sound board.

DOS, version included DOS implies MS-DOS, unless otherwise specified. WFWG denotes Windows for Workgroups, and Win indicates Windows.

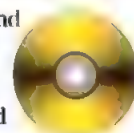
A Plug and Play BIOS can map out motherboard resources to ease upgrades when used with a Plug and Play-compliant operating system (such as Windows 95 or forthcoming versions of OS/2).

Expansion-bus slots PCI cards may share a backplane with ISA cards, meaning that you can use one or the other but not both simultaneously. These shared slots are listed as PCI/ISA.

For an interactive CD-ROM kit that will answer a lot of your questions, call 1-800-527-3753, Ext. 1009.



Call now or contact us at <http://www.hp.com/info/1009> and we'll send you an interactive CD-ROM plus additional information about the HP LaserJet 5Si MX. The CD-ROM employs 3-D animation and sound to present an interactive demonstration of the software, features, and other options in this incredible machine. And while you're looking, bear in mind that the HP LaserJet 5Si MX and 5Si are both priced lower than their predecessors. Which leaves just one last question to be answered, "What are you waiting for?"



- 24 ppm printing
- 12MB of memory (4MB in the 5Si)
- 3 standard input sources
- Broad paper handling capabilities
- 100,000 page/month duty cycle

HP Network Printers
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SQL Server (3-User). All were designed from the start for client/server. Apart, each tool is best in its class. Together, they deliver the most potent

client/server solutions available, at about half the retail price. A good deal, indeed.

StarDesignor: Data modeling made easy. Start your applications with a good data model, using StarDesignor's reverse engineering and database construction capabilities.

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CIRCLE 345 ON READER SERVICE CARD

SUMMARY OF FEATURES

Windows 3.x Pentium PCs

■ YES ■ NO	ALR Evolution V ST/133	ALR Optima 590	ALR Optima 5120	AT&T Globalyst 630	AT&T Globalyst 730	Compaq Deskpro 5100	Compaq Deskpro XL 5120
Products listed in alphabetical order by company							
Street Price (tested configuration)	\$4,357	\$2,799	\$2,999	\$3,880	\$5,380	\$3,542	\$4,924
Processor	Pentium/133	Pentium/90	Pentium/120	Pentium/100	Pentium/133	Pentium/100	Pentium/120
Installed RAM	16MB	16MB	16MB	16MB	16MB	16MB	16MB
Hard disk capacity and interface	1.5GB EIDE	1GB EIDE	1GB EIDE	1.5GB EIDE	1.5GB EIDE	1GB EIDE	1GB SCSI-2
Graphics adapter (and memory)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Integrated S3 Trio32 (2MB DRAM)	Integrated S3 Trio32 (2MB DRAM)	Integrated S3 Trio64 (2MB DRAM)	Integrated S3 Vision968 (2MB VRAM)	Integrated QVision 1280/P (1MB VRAM)	Matrox IS-Athena R1 (2MB VRAM)
Monitor (and diagonal screen size)	MAG InnoVision DX15Fe (15")	MAG InnoVision DX15Fe (15")	MAG InnoVision DX15Fe (15")	AT&T 7156 (15")	AT&T TX-D1751L (17")	Compaq 151FS (15")	Compaq QVision 172 (17")
Network adapter	Cogent EM960	Cogent EM960	Cogent EM360	SMC EtherEZ 8416	SMC DST 9332	Compaq NetFlex-3/E	AMD PCNet
Network adapter interface	PCI card	PCI card	PCI card	ISA card	PCI card	Motherboard PCI	Motherboard PCI
CD-ROM drive	Mitsumi CRMC- FX400	Mitsumi CRMC- FX400	Mitsumi CRMC- FX400	Sony CDU76E	Sony CDU76E	Sony CDU76E	Matsushita CR-503-B
Drive speed and interface	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	2x SCSI
Sound adapter	Creative Labs Sound Blaster 16	Creative Labs CT226	Creative Labs CT226	Creative Labs CT2260	ESS Technologies ES688F	None	Analog Devices SoundPort
Sound adapter interface	ISA card	ISA card	ISA card	ISA card	Motherboard	N/A	Motherboard
Speakers/modem included	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
DOS, Windows version included	6.22, Win 3.11	6.22, Win 3.11	6.22, Win 3.11	6.22, Win 3.11	6.22, Win 3.11	6.2, Win 3.1	6.2, Win 3.1
Motherboard Components							
Installed external RAM cache and type	256K pipelined burst	256K asynchronous	256K asynchronous	256K synchronous	1MB synchronous	256K pipelined burst	256K pipelined burst
Motherboard manufacturer	ALR	Intel	Intel	AT&T	AT&T	Compaq	Compaq
Chip set manufacturer and model	Intel Triton	Intel Triton	Intel Triton	VLSI VL82C591, VL82C592, VL82C593	VLSI VL82C591, VL82C592, VL82C593	Compaq	Compaq
BIOS manufacturer and version	Phoenix 4.04.1	AMI 1.00.03 BTO	AMI 1.00.03 BTO	Phoenix 4.04	Phoenix 4.05	Compaq 486G	Compaq 486W
Flash BIOS/Plug and Play BIOS	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Multiprocessor socket	■	■	■	■	■	■	■
Expandability							
Maximum RAM	128MB	128MB	128MB	192MB	192MB	192MB	144MB
Expansion-bus slots	4 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 1 PCI, 1 PCI/ISA	2 ISA, 1 PCI, 1 PCI/ISA	5 ISA, 3 PCI	6 ISA, 2 PCI	3 ISA, 1 PCI, 1 PCI/ISA, 1 proprietary	3 EISA, 1 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	3, 1	2, 2	2, 2	3, 1	3, 1	3, 1	3, 0
Internal drive bays (5.25", 3.5")	0, 2	0, 0	0, 0	0, 2	0, 2	0, 1	0, 1
Power-supply wattage	250W	201W	201W	250W	250W	185W	244W
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 1, 1	1, 1, 1	1, 2, 1
EPP/ECP parallel interfaces supported	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Service and Support							
7-day, 24-hour live technical support	■	■	■	■	■	■	■
Standard warranty on parts/labor	5 years/3 years	5 years/3 years	5 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years	3 years/3 years
On-site service charge	\$9.95 (1 year)	\$9.95 (1 year)	\$9.95 (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)

N/A—Not applicable: The product does not have this feature.

erator card with 2MB of Window RAM. While the P5-100 used a 1GB hard disk, the P5-133XL had a larger, 1.5GB model.

These Gateway computers also came with some great extras, including Microsoft Office 4.3 and a 28.8-/14.4-Kbps data/fax modem. The two units used the same type of Ethernet card, SMC's EtherPower card with RJ-45 connectors (a Token-Ring card is also available for \$279).

The P5-100 was the one unit tested for this story with no L2 cache included, which resulted in a below-average CPUmark₁₆ score. The system's Disk WinMark 96 score was above average, its Winstone 96 score was average, and its Graphics WinMark 96 score was below average.

The P5-133XL posted average scores for its processor class on both the Winstone and Disk WinMark tests. Its

Graphics WinMark score fell below the average.

Gateway includes a three-year-parts, one-year-labor warranty, with one year of on-site service for both systems. Telephone technical support is available 24 hours, 7 days.—WPF

Gateway 2000 Inc., N. Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2465.

Circle 470 on reader service card

Continues

Compaq ProLinea 5100	Dell Dimension XPS P133c	Dell OptiPlex GM+5100
\$3,358	\$3,898	\$3,092
Pentium/100	Pentium/133	Pentium/100
16MB	16MB EDO	16MB EDO
1GB EIDE	1GB Fast ATA-2	1GB EIDE
Integrated Cirrus Logic GD5434 (1MB DRAM)	Number Nine Imagine 128 (4MB VRAM)	Integrated S3 Trio64 (2MB DRAM)
Compaq 1024 Color Monitor (14")	Dell UltraScan 17XE (17")	Dell UltraScan 15TE (15")
Compaq NetFlex-3/E	3Com EtherLink III	3Com EtherLink III
PCI card	PCI card	Motherboard PCI
Sony CDU76E	Hitachi CDR-7730	NEC CDR-272
4x ATAPI	4x ATAPI	4x ATAPI
None	Creative Labs CT2260	Creative Labs CT2260
N/A	ISA card	ISA card
■ ■	■ ■	■ ■
6.2, Win 3.1	6.2, Win 3.11	6.2, Win 3.11
256K pipelined burst	256K pipelined burst	256K asynchronous
Compaq	Intel	Dell
Compaq	Intel Triton	Intel Triton
Compaq 488G3	AMI A02	Phoenix/Dell 1.10 A00
■ ■	■ ■	■ ■
192MB	128MB	128MB
3 ISA, 1 PCI, 1 PCI/ISA, 1 proprietary	3 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 2 PCI/ISA
3.1	3.1	3.0
0.1	0.2	0.2
185W	230W	145W
1, 1, 1	1, 2, 1	1, 2, 1
■ ■	■ ■	■ ■
■	■	■
3 years/3 years Included (1 year)	3 years/1 year Included (1 year)	3 years/1 year Included (1 year)

IBM PC Direct PC 300

The \$4,688 IBM PC 300 includes a 17-inch monitor and offers solid performance. Though some may find the riser card design of this DMI-compliant Pentium/133-based system slightly limiting, IBM positions this desktop unit as a workstation for large businesses, where it should serve well.

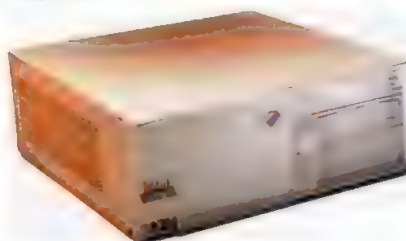
IBM also markets the PC 700 series (not reviewed), aimed at the high-end corporate market. Two added attractions of both this and the PC 300 line are IBM's NetFinity client software, which handles asset management and allows for remote diagnostics, and the Rapid Resume feature, familiar to notebook users, which allows you to start where you left off and lets you set the system to "wake up" if, for example, you get a call coming through to your modem.

The PC 300's motherboard leaves little room for added expansion cards. Only one of the board's three ISA slots is open; the other two slots are shared ISA/PCI slots. One is taken by an (\$149) EtherLink III PCI card, which provides 10Base-T, 10Base2, and 10Base5 network connections. A Token-Ring card costs \$148. Despite the fact the motherboard has an integrated S3 Trio64 chip set, IBM chose to install an optional (\$399) Diamond Stealth Graphics PCI card in the unit's second ISA/PCI slot.

The PC 300's performance on our benchmark tests was good. Its Graphics WinMark 96 score was slightly above average, and its Winstone 96 and Disk WinMark 96 scores were both average for its group.

IBM provides a three-year warranty on parts and labor for the PC 300, which includes one year of on-site service. Two additional years of on-site service are priced at \$70. IBM offers 24-hour, 7-day technical support and a special technical support line for corporate customers.—WPF
IBM PC Direct,
Raleigh, NC; 800-426-2968; fax, 800-426-3395.

Circle 471 on reader service card



Micron Electronics Inc. P100 Millennium, P133 Millennium

The \$3,147 P100 Millennium and the \$3,546 P133 Millennium (street prices), from Micron Electronics, may look like your average mini-towers, but close inspection reveals them to be powerful, no-nonsense workstations that will suit home and power users alike. Micron primarily targets the home-office market with the P100 and acknowledges that the P133, although positioned primarily as a workstation for the corporate business market, has found itself a place in the home office as well.

The P133 came equipped with a 1.5GB hard disk and a sextuple-speed CD-ROM drive (versus the P100's 1GB hard disk and quad-speed CD-ROM drive), but aside from these components, the two systems are exactly the same. Both units used PCI-based Diamond Stealth graphics accelerator cards with S3's Vision968 graphics engine, and each included a 15-inch monitor. Both also came equipped with SMC's EtherPower Ethernet cards, which support 10Base-T, 10Base2, and 10Base5 networks (a \$249 option included in the prices cited above). An optional Token-Ring card is available for \$100.

The P100 Millennium outpaced its competition by wide margins on all of our Windows-based benchmark tests. In fact, it turned in scores that rivaled the performance of some 133-MHz units we tested.

The P133 Millennium also did well on our battery of benchmark tests, posting the highest Winstone 96 score of its Pentium/133 CPU group. The unit's Graph-



IN SHORT
High-performing, fully loaded systems of the kind we've come to expect from Micron.

SERVICE & RELIABILITY

Micron Electronics Inc.	
Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Average

IN SHORT
Good performance and networking software make this PC an attractive corporate workstation.

SERVICE & RELIABILITY

IBM PC Direct	
Reliability	Better than average
Repair	Better than average
Technical support	Better than average
Percent needing repair	Better than average

SUMMARY OF FEATURES

Windows 3.x Pentium PCs



■ YES □ NO

Products listed in alphabetical order by company

	Dell OptiPlex GXMT-5133	Digital Celebris GL 5120st	Digital Ventures 5100	Gateway P5-100	Gateway P5-133XL	IBM PC 300	Micron P100 Millennia
Street price (tested configuration)	\$3,864	\$4,273	\$3,906	\$2,896	\$3,906	\$4,688	\$3,147
Processor	Pentium/133	Pentium/120	Pentium/100	Pentium/100	Pentium/133	Pentium/133	Pentium/100
Installed RAM	16MB EDO	16MB EDO	16MB	16MB EDO	16MB EDO	16MB EDO	16MB EDO
Hard disk capacity and interface	1GB EIDE	1.5GB EIDE	1.2GB EIDE	1GB EIDE	1.5GB EIDE	1GB Fast ATA-2	1.2GB EIDE
Graphics adapter (and memory)	Integrated S3 Trio64V+ (2MB DRAM)	Integrated Matrox MGA Millennium (2MB VRAM)	Integrated S3 Trio64 (1MB DRAM)	Matrox MGA Millennium (2MB VRAM)	Matrox MGA Millennium (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)	Diamond Stealth 64 Video VRAM (2MB VRAM)
Monitor (and diagonal screen size)	Dell UltraScan 17XE (17")	Digital PCXCV-AC (15")	Digital PCXBV-PC (15")	Sony Vivitron 1572 (15")	Sony Vivitron 1776 (17")	IBM P70 (17")	ADI 15FGx (15")
Network adapter	3Com EtherLink III	Digital 21040	Digital EtherWorks Turbo DE435	SMC EtherPower PCI	SMC EtherPower	3Com EtherLink III	SMC EtherPower
Network adapter interface	Motherboard PCI	Motherboard PCI	PCI card	PCI card	PCI card	PCI card	PCI card
CD-ROM drive	NEC CDR-272	Mitsumi CRM- FX400	Mitsumi CRM- FX400	Mitsumi CRM- FX400	Mitsumi CRM- FX400	Mitsumi CRM- FX400	Sanyo CRD-254P
Drive speed and interface	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI	4x ATAPI
Sound adapter	Creative Labs Vibra 16	ESS Technologies Audio Drive	Ensoniq Soundscape	Creative Labs CT2260	Creative Labs CT2260	Creative Labs Sound Blaster 16	Creative Labs CT2260
Sound adapter interface	Motherboard	Motherboard	ISA card	ISA card	ISA card	ISA card	ISA card
Speakers/modem included	■	■	■	■	■	■	■
DOS, Windows version included	6.2, WinW 3.11	6.22, WinW 3.11	6.22, WinW 3.11	6.22, WinW 3.11	6.22, WinW 3.11	IBM PC DOS 6.3, WinW 3.11	6.22, WinW 3.11
Motherboard Components							
Installed external RAM cache and type	256K pipelined burst	256K pipelined burst	256K asynchronous	None	256K pipelined burst	256K asynchronous	256K synchronous
Motherboard manufacturer	Dell	Digital	Digital	Intel	Intel	IBM	Micronics
Chip set manufacturer and model	Intel Triton	Intel Triton	SiS 85C501, 85C502, 85C503	Intel Triton	Intel Triton	Intel Triton	Intel Triton
BIOS manufacturer and version	Phoenix/Dell 1.10 Y00	Phoenix 4.04	Phoenix 4.05	AMI 1.00, 03 BROT	AMI 1.00.03 BROT	AMI 0.11.02, CCOM	Phoenix 4.04
Flash BIOS/Plug and Play BIOS	■	■	■	■	■	■	■
Multiprocessor socket	■	■	■	■	■	■	■
Expandability							
Maximum RAM	128MB	128MB	128MB	128MB	128MB	128MB	128MB
Expansion-bus slots	4 ISA, 2 PCI/ISA	3 ISA, 1 PCI, 1 PCI/ISA	1 ISA, 1 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 2 PCI/ISA	4 ISA, 3 PCI, 1 PCI/ISA
Accessible drive bays (5.25", 3.5")	3, 1	3, 1	1, 1	3, 1	4, 1	2, 1	3, 1
Internal drive bays (5.25", 3.5")	0, 2	0, 3	0, 2	0, 3	0, 4	0, 2	0, 2
Power-supply wattage	224W	200W	100W	145W	145W	100W	200W
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1
EPP/ECP parallel interfaces supported	■	■	■	■	■	■	■
Service and Support							
7-day, 24-hour live technical support	■	■	■	■	■	■	■
Standard warranty on parts/labor	3 years/1 year	3 years/3 years	3 years/3 years	3 years/1 year	3 years/1 year	3 years/3 years	1 year/1 year
On-site service charge	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)

ics WinMark score was above the average, while its Disk WinMark score was average.

Micron includes a one-year warranty on parts and labor as well as one year of on-site service with these systems. —WPF

Micron Computer Inc., Nampa, ID; 800-388-6334, 208-463-3434; fax, 208-463-3424.

Circle 472 on reader service card

NEC Technologies Inc.

PowerMate V100



The DMI-compliant, Pentium/100-powered NEC PowerMate V100—one of our Editors' Choice selections in this review—is newly redesigned and packed with a sextuple-speed CD-ROM drive, an IRDA-compliant infrared port,

and MPEG support for the corporate buyer. It also includes a number of features, such as a software startup guide, color-coded cables, and desktop management software, that make it user-friendly in any market. A \$2,849 street price (the "V" stands for value) and solid performance make the unit an even more attractive choice. NEC also markets the Powermate P performance series for corporate power users.

Ends

PC MAGAZINE
EDITORS' CHOICE

Micron P133 Millennia	NEC PowerMate V100	ZDS Z-Station GT
\$3,546	\$2,849	\$4,117
Pentium/133	Pentium/100	Pentium/120
16MB EDO	16MB EDO	16MB
1.5GB EIDE	1GB Fast ATA-2	1.2GB EIDE
Diamond Stealth 64 Video VRAM (2MB VRAM)	Integrated Alliance Pro Motion 6422 (2MB DRAM)	Integrated S3 Trio64 (2MB DRAM)
ADI 15FBx (15")	NEC MultiSync XE15 (15")	Nokia 447E (17")
SMC EtherPower	3Com EtherLink Power	SMC EtherEZ III
PCI card Piaxlor PX-63CS	ISA card NEC CDR-502	ISA card Toshiba XM- 5302TA
6x SCSI Creative Labs Sound Blaster AWE32	6x SCSI-2 OPTI 82C930A	4x ATAPI Creative Labs Sound Blaster 16
ISA card ■ ■	Motherboard ■ ■	ISA card ■ ■
6.22, WWSG 3.11	6.22, WWSG 3.11	6.22, WWSG 3.11
256K synchronous Micronics Intel Triton	256K pipelined burst NEC Intel Triton	256K asynchronous Intel Intel Triton
Phoenix 4.05 ■ ■	Phoenix 4.05.4 ■ ■	AMI 1.00.01CA0U ■ ■
128MB 4 ISA, 3 PCI, 1 PCI/ISA 3.1 Q. 2 200W 1, 2, 1 ■ ■	128MB 3 ISA, 1 PCI, 1 PCI/ISA 3.1 Q. 4 200W 1, 2, 1 ■ ■	128MB 1 ISA, 1 PCI, 1 PCI/ISA 2.1 Q. 1 145W 1, 1, 1 ■ ■
1 year/1 year Included (1 year)	3 years/3 years Included (1 year)	3 years/3 years Included (1 year)

The mini-tower V100's motherboard had a riser card design and integrates an audio chip as well as an Alliance Pro-Motion 6422 graphics accelerator chip set with MPEG support. The unit also came with a 3Com EtherLink III 3C509B-Combo Ethernet card, which supports 10Base-T, 10Base2, and 10Base5 networks. A 100Base-T card is optional, for \$199.

To make things easier for users, NEC

ships the unit with a large poster that has a setup guide on one side and a guide to NEC's on-line support on the other. The on-line support includes an MIF browser with more than 160 attributes, as well as the NEC Technical Service (which you can dial into through a modem or access from a network through the Internet) and the NEC BBS.

The V100 posted mostly average scores across our Windows-based benchmark tests. It did have one above-average score—on our Disk WinMark 96 tests.

NEC includes toll-free technical support 24 hours a day, 7 days a week; a three-year warranty with one year of on-site service; and a \$99 on-site service option for 3 years, which has an 8-hour response time. NEC also provides a separate technical-support telephone line for corporate customers. —WPF

NEC Technologies Inc., *Boxborough, MA; 800-632-4636; fax, 800-366-0476.*

Circle 473 on reader service card

Zenith Data Systems Z-Station GT

Zenith Data Systems' Z-Station GT, with a street price of \$4,117, has attractive components such as a 17-inch monitor, 64-bit graphics, a 1.2GB hard disk and 256K of L2 cache. Though its performance was not stellar, its components should succeed in pleasing its intended audience of corporate buyers. ZDS also offers a Z-Station VP line,



aimed at more cost-conscious buyers in the corporate, educational, and federal markets.

There is little room for additional components in this slimline case (identical to the one used by the ALR Optima 5120, one of only two other systems in the 120-MHz class in this portion of the roundup). Only one PCI expansion slot and one ISA slot are available, and only one drive bay is free.

Though ZDS has become known for its built-in networking solutions, the model we tested used an ISA-based Ethernet SMC EtherEZ 8416 card for 10Base-T networks (integrated Ethernet controllers are available on the Z-Station 500 and 510). An optional Token-Ring card is available for \$237. ZDS does offer integrated graphics in this model, however, by means of S3's Trio64 chip set.

The Z-Station GT was not a top performer on our benchmark tests. It posted a slightly better score than the ALR Optima on the Winstone 96 tests and a much better score on the Graphics WinMark 96 tests, but it lagged slightly behind the ALR unit on the Disk WinMark 96 tests.

Neither system compared favorably with the other 120-MHz entry in our roundup, the Digital Celebris GL 5120st, which posted significantly better scores on every benchmark test. In fact, both the ZDS and ALR systems performed more on a par with 100-MHz Pentium PCs than what we would expect from 120-MHz units.

ZDS also includes an Internet browser package with the system. The Z-Station also comes with a three-year warranty and one-year of on-site service, and ZDS offers remote diagnostic capabilities and as well as DMI support. □

—WPF

Zenith Data Systems, *Buffalo Grove, IL; 800-533-0331, 708-808-5000; fax, 800-472-7211.*

Circle 474 on reader service card



IN SHORT

This 100-MHz Pentium system is packed with hardware and software for the corporate user.

SERVICE & RELIABILITY NEC Technologies Inc.

Reliability	Average
Repair	Average
Technical support	Average
Percent needing repair	Better than average

IN SHORT

Good choice as a standard corporate workstation, but lacking in performance.

SERVICE & RELIABILITY Zenith Data Systems

Reliability	Worse than average
Repair	Worse than average
Technical support	Worse than average
Percent needing repair	Average



GRAPHICS ACCELERATORS

DISPLAY MATES

The latest collection of graphics accelerator boards don't just pump up mainstream graphics. They improve your video playback, too. PC Labs tests 23 boards that promise to dazzle your eyes.

By Jeff Mace

An accelerated graphics adapter board continues to be one of the most important components of your PC. And while the boards have become quite adept at blasting pixels quickly from system to screen, new challenges await. Fast and affordable Pentium processors have helped open the door for an ever-widening array of multimedia and graphics in applications and on CD-ROM. Graphics board vendors, as expected, have raised the bar with a whole new breed of accelerator boards designed to take advantage of these opportunities.

Once the purview of specialty add-in boards and daughtercards, digital video acceleration has finally moved right in and become part of the mainstream graphics adapter board. These full-featured, integrated boards cost no more than products that did half the work one year ago.

Even if you don't envision yourself viewing full-motion video at your desktop, the types of operations these boards accelerate reach far beyond playing movie clips. New specifications for Microsoft Windows 95 under the moniker DirectX will promote a variety of new types of graphical events, such as sprites (continuously animated, on-screen objects), high-speed animations, transparent blitting (moving a block of bits from main memory to video memory) and 3-D.

You can be sure that software developers will welcome these new capabilities and quickly incorporate all sorts of new bells and whistles into their mainstream tools. To find out more about these new technologies and the DirectX architecture see the sidebar "Call DirectX: Multimedia Games Get Windows' Number."

Mainstream Accelerator Boards

In this story, we evaluate 23 accelerator boards with multimedia features that deliver powerful, multifeatured performance at a list price of under \$400. We tested products that were FCC Class B approved, had 2MB of memory, could accelerate both Windows graphics and digital video, offered hardware-assisted video scaling, and were available for the PCI bus and shipping by August 17, 1995. (We don't test the VL-bus versions of boards but report on their availability in the Summary of Features that follows.)

We began our evaluation just as Microsoft shipped Windows 95, a time of great change throughout the PC industry. At this writing, many products are in transition or getting a face lift in the form of Windows 95 driver development or DirectDraw and DirectVideo support (the new operating system's components for enabling video acceleration).

While some of these factors precluded products from shipping in time for this review, such as the Paradise from Western Digital and the Fahrenheit 64VA from Orchid, we do examine these products' performance under Windows 95. Our final analysis and measure of hardware performance were made on Windows 3.x, because at the time of testing, that was the only true way to measure hardware and digital video playback performance.

By the time you read this, Windows 95 will have been shipping for nearly four months. Nevertheless, the graphics accelerator market is still a hodgepodge of boards, some Windows 95-reliable and some not, with almost none optimized to run as it should under the new operating system. Who's to blame? Although some believe that board makers had ample time to produce stellar Windows 95 drivers, we think the late release of the Direct SDK and some last minute architecture changes by Microsoft (leaving board vendors no way to directly access the hardware for digital video playback) have made it almost impossible for vendors to create fully optimized drivers for

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the new OS in this time frame.

Expect complete and optimized Windows 95 support to trickle in as each vendor readies its drivers.

A NEW WORLD

The Windows 95 development effort required participation from leading graphics accelerator vendors in aspects of the design and testing phases of the new display subsystem, which differs greatly from that of Windows 3.x.

To let display boards work with Windows 95 immediately, Microsoft has designed a minidriver architecture that vendors can use to make their products compatible quickly. What makes this possible is Windows 95's 32-bit DIB (device independent bitmap) engine and a universal display driver that it talks to.

The DIB engine specifically takes advantage of 32-bit features offered in 386 and above CPUs and executes Windows GDI calls, like the movement and rendering of memory bitmaps, with enhanced speed. The universal driver supports device-dependent code, written by the board vendor in the minidriver, which then communicates directly to the low-level circuitry in the hardware. The optimization of Windows 95 drivers for speed is a process of bypassing the DIB engine for routines that can be processed more rapidly by a board's hardware. Your best board, however, may not be

the fastest. Whatever you choose, though, the display adapter board in many respects establishes the only human link with all the fancy hardware inside your system.

NEW CHIPS IN EVIDENCE

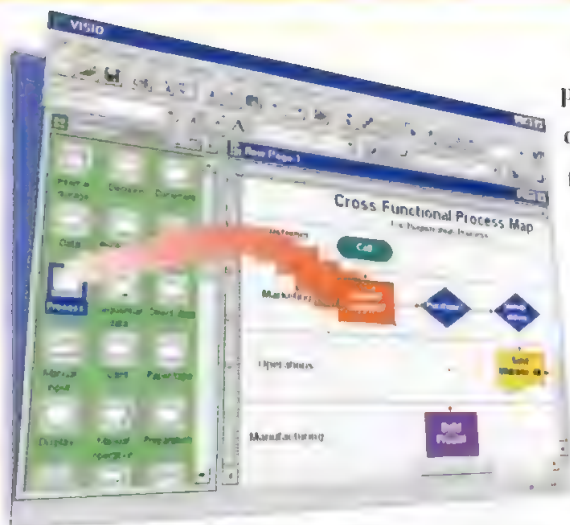
Recently released integrated controller chips from vendors like Alliance, S3, and Trident are built in to several products in this review. There are also two new interesting solutions from Focus Information Systems and Hercules, which are based on the combined strengths of the ARK2000PV controller chip and the ZoomDAC, from IC Works.

The ZoomDAC, in particular, is worth noting. In addition to doing the RAMDAC's job of transposing frame-buffer data from a digital format to analog format, the ZoomDAC is able to recognize whether that video data stream needs to be scaled.

The new S3 Trio 64V+, featured on the Diamond Stealth64 Video 2201XL and STB Systems' Powergraph 64 Video, also has some tricks for handling the high bandwidth typically required for video data streams. With a graphics controller, video engine, clock synthesizer, and DAC built into a single design, this chip's first service is to cut down on physical parts. What's more, using a unified frame-buffer approach, this part can play video in an overlay mode.

The Trident TGUI9680 chip on the Asicom Totem 64V board also features an integrated controller, DAC, video engine, and clock synthesizer. Like the S3 Trio 64V+, an overlay mode is used for video. Alliance Semiconductor's new so-

Our Contributors: BRUCE BROWN and JOHN R. QUAIN are contributing editors of *PC Magazine*. HOWARD ALEXANDER, JON HILL, and JAN OZER are frequent contributors to *PC Magazine*. LARRY SELTZER is a technical director of *PC Magazine*. LANCE ULANOFF was the senior associate editor in charge of this story, and JEFF MACE was the project leader.



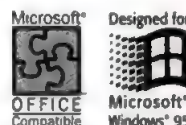
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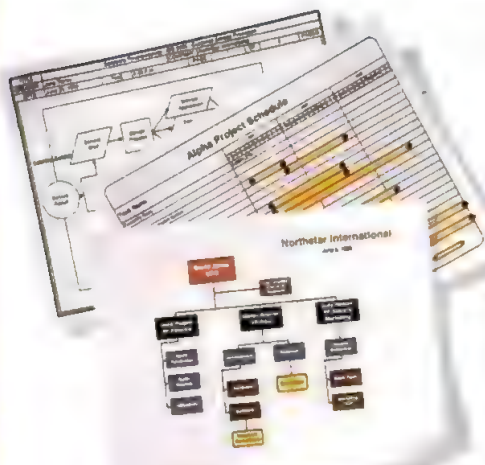
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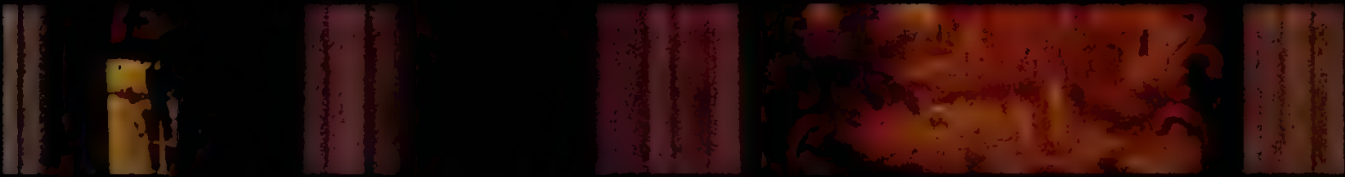
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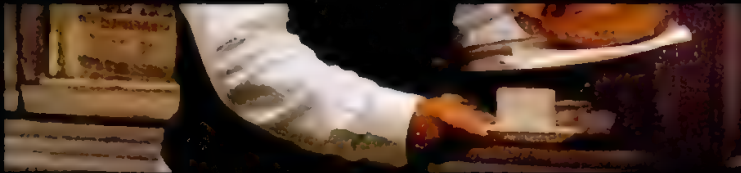




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lution, the ProMotion 6410, is a graphics and video accelerator chip that is present on Alaris's Matinee and on Focus Information Systems' OptiView Pro. It combines a potent scaling engine, which uses the ProMotion's proprietary antiblocking circuitry to obtain smooth, nonblocky digital video playback.

These chips take a new and more effective approach to video scaling than the chips found in ATI's mach64, Matrox's MGA2064W, and S3's Vision968. The older chips were developed primarily to accelerate graphics calls, and these VRAM/WRAM-based chips continue to remain the fastest at doing so. But specialized video processors such as the Weitek Power Player 9130 continue to provide superior scaling performance.

NEW TESTS

Each fall, PC Labs releases the newest version of its Benchmark Tests. We used PC Labs WinBench 96 and Winstone 96 benchmark tests to test the products in this roundup. Read the Lab Notes column located in this issue's PC Tech section for a detailed description of the new features and tests. In this roundup, we present the benchmark results in chart form and provide a detailed analysis in the sidebar "What the Numbers Mean" to help you understand how best to interpret our findings.

Many of the products we look at here are designed by the vendor specifically to meet specific users' needs and budgets. For example, more affordable products that use the less expensive EDO DRAM will cost less and perform somewhat slower at color depths above 8-bit (256 colors) when compared with VRAM-based boards.

Look for discussions in the reviews about bundled software and warranty information to get a better idea of what you're getting for your money. Refer to the Summary of Features in these pages for a list of specific product abilities, such as maximum color depths and bundled drivers. What may ultimately wind up as your best decision-making assistant is our price/performance index. Here, you will get a visual clue as to where the board you are eyeballing sits in terms of price, performance, and reference to other boards reviewed in the following pages.

Diamond Stealth64 Video 2201XL

There's lots of good news for users of mainstream graphics acceleration boards. The latest products have gotten more powerful and less expensive at the same time. One board, the Diamond Stealth64 Video 2201XL, epitomizes this trend and earns an Editors' Choice.

Diamond Multimedia Systems' affordable board features 2MB of EDO DRAM and costs only \$249. It also turned in above-average WinBench 96 numbers and posted above-average scores on our real-world Winstone 96 tests. Even more important, the Diamond board was among the few in this roundup that didn't have disappointing digital video playback performance.

This achievement is due mostly to S3's powerful 64-bit Trio64V+, an integrated graphics and video controller chip that can play back digital video in its native color depth, regardless of your display settings. Visual quality was also high. Diamond bundles MPEG-playback software and a feature connector that stands ready to connect to its add-on cards; some are as low as \$100 apiece.

In addition, the expert tools bundled with the Diamond board make it shine. Inside the box you will find three powerful applications: Asymetrix's 3D/FX 3-D object/image builder, CorelDraw 4 design and illustration software, and Digital Video Producer digital video editing software.

As always, Diamond's drivers and controls are stellar. Along with ATI Technologies, Matrox Graphics, and Number Nine Visual Technology Corp., Diamond has set the standard for display control under Windows 3.1. Driver stability was also exceptional; the Diamond Stealth64 Video 2201XL was among the few boards to sail through our new benchmark tests without crashing.

Four other boards are worthy of honorable mention: The \$379 Matrox

Graphics MGA Millennium is clearly the choice for users who are less price-sensitive and demand the ultimate in mainstream graphics performance. The Millennium was the top performer on our Winstone tests. Its 220-MHz TVP3026 DAC and fast WRAM helped it support high refresh rates that yielded saturated, flicker-free displays.

The Millennium is also notable for its excellent and extensive feature set, utilities, and control panel under Windows 95 (as well as Windows 3.1).

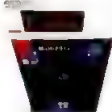
Number Nine Technology Corp.'s S3 Vision968-based 9FX Motion771 (\$329) was one of the most consistent performers on our tests, and its Hawkeye Display controls are quite good. Like the Millennium, though, it's one of the more expensive boards in the roundup.

ATI Technologies' \$349 Winturbo continues to perform well on our graphics tests and also features strong utilities. Like Matrox and Number Nine, ATI uses faster and more expensive VRAM or WRAM, and that accounts for its relatively high price point.

STB System's \$229 Powergraph 64 Video, an affordable, S3 Trio64V+-based board, performed nearly as well as the Diamond Stealth64 Video 2201XL board on our video benchmark tests. Though not a top performer on our graphics benchmark tests, it's no slouch, and STB bundles the board with some entertaining games and useful family and home applications. Still, STB's utilities have a few rough edges, and unlike the Diamond board, it couldn't reliably complete our torture tests.



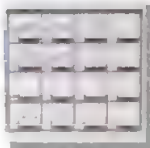
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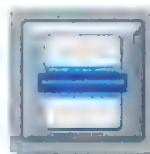


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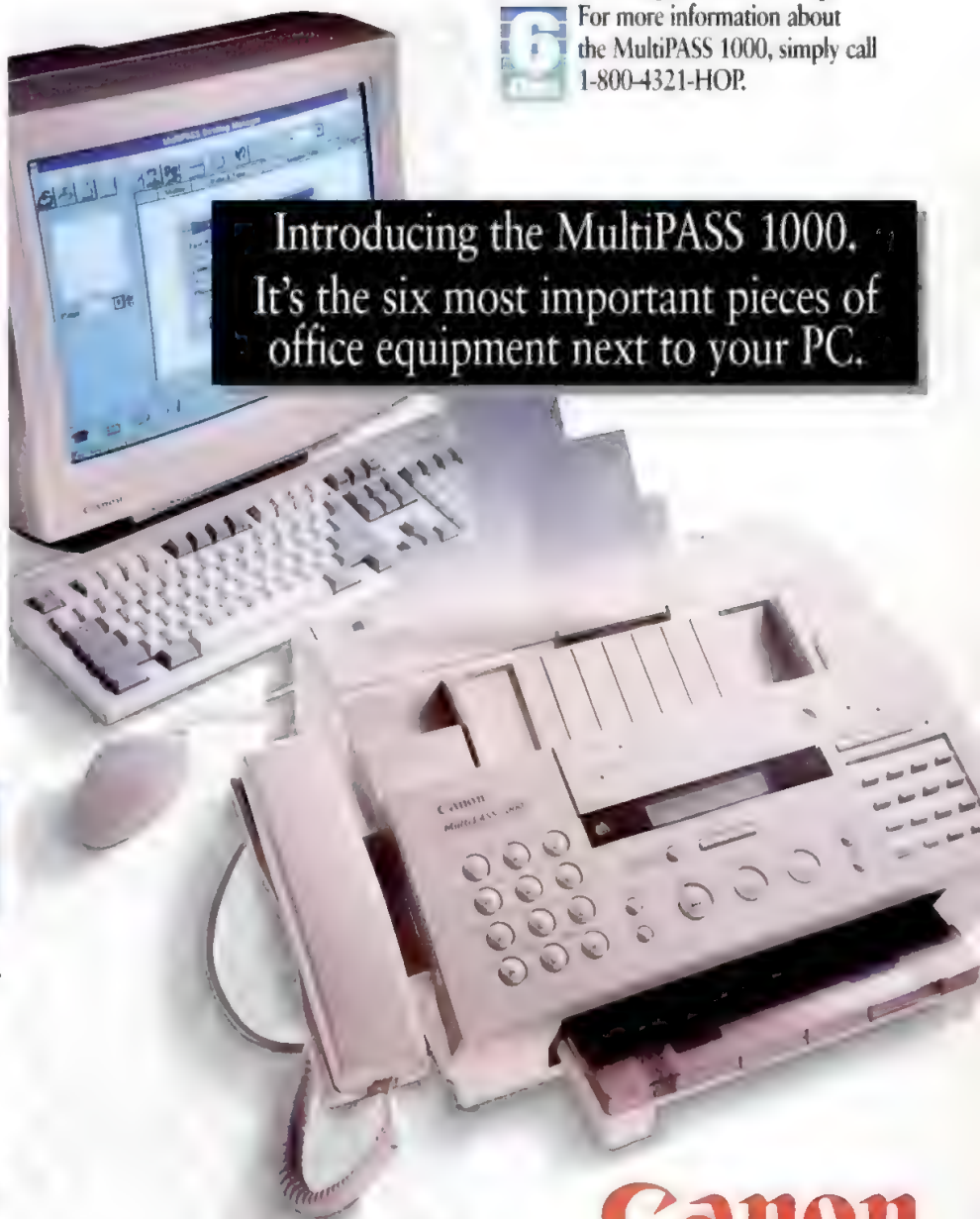


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Graphics for Dollars: Price/Performance Index

Our price/performance index (also affectionately known as the "Bang for the Buck Chart") may be the best way to assess how much value for the dollar you're getting when you buy one of our tested boards.

The position of each product within the matrix represents the convergence of the list price and the performance score for each product. Those boards that are nearer the upper-right-hand corner offer the best price/performance ratio (or bang for the buck). Alternatively, those boards in the lower-left-hand corner offer the fewest features and the least impressive performance at the highest price.

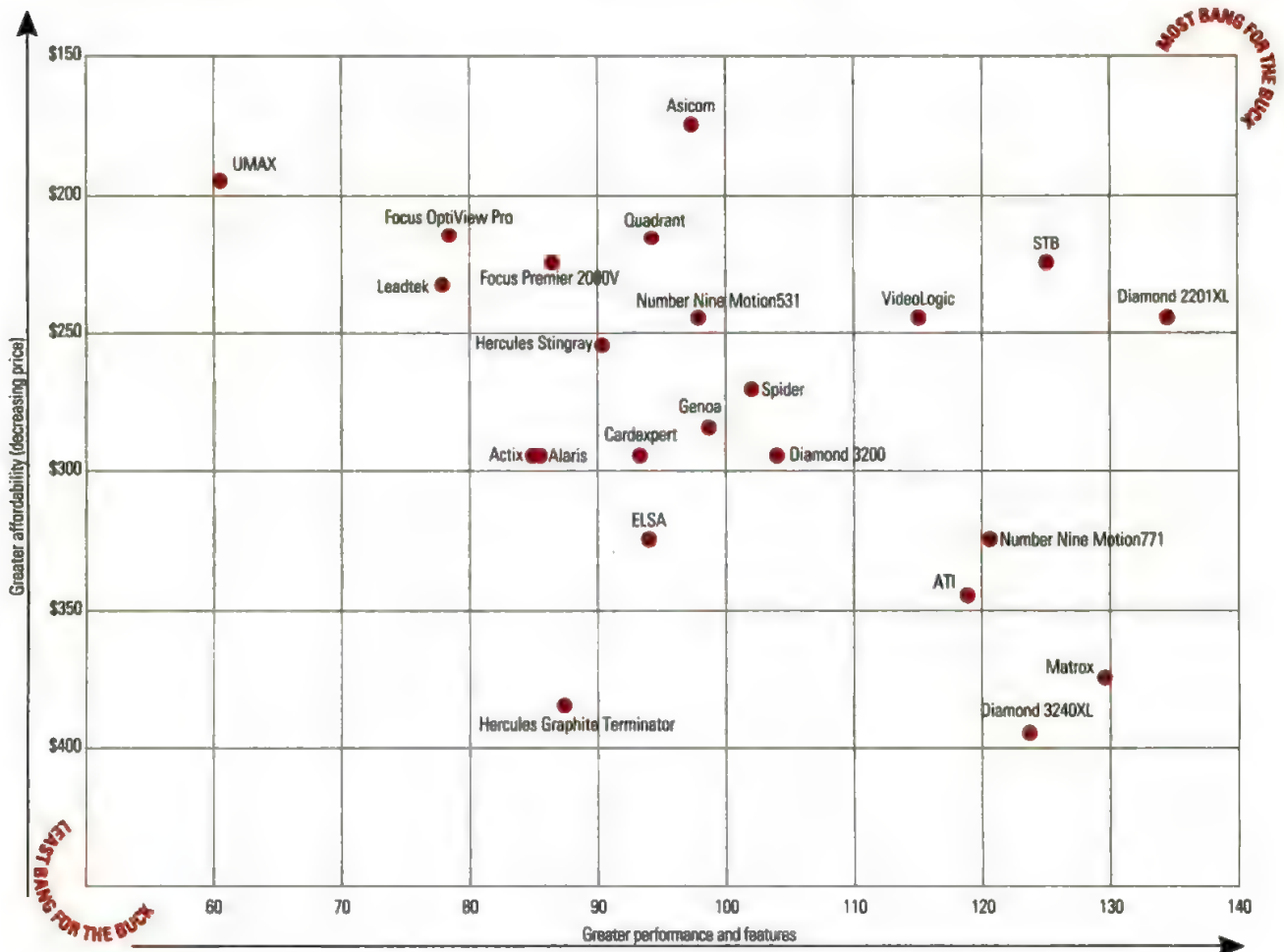
Our bang rating is built from

weighted scores in more than a dozen different categories, including benchmark performance, features, and general usability. Every score is weighted according to relevancy to your buying decision.

We start with Winstone and WinBench ratings in our two test resolutions (under Windows 3.1 only). In addition, we include scores for construction quality, for driver stability, and for bundled drivers (including drivers for native Windows 95, OS/2 Warp Connect, Windows NT 3.5, and AutoCAD). The quality of bundled utilities and software also figures here as well as whether MPEG playback software is bundled, whether there's DCI support for Windows 3.1,

and whether the card meets VESA refresh-rate compliance. Upgrade paths and expandability are also rated, as is the level of technical and warranty support.

To calculate a bang score for each product, we first look at the maximum and minimum ratings in each category and arrive at a mean score. The next step is to divide each rating by the mean for all scores in that category. Then that rating is weighted along with all the others to reach a total of 100 percent. The weighted scores are summed according to their weighted measures and then divided by the total. That number is then normalized to achieve our Bang score.



Actix Systems Inc.

GraphicsEngine Ultra 64 AV

Actix Systems' GraphicsEngine Ultra 64 AV (\$299) ships with a minimal set of software utilities, but if virtual displays and "spyglass" hotkeys make you yawn, you could do worse than find an Ultra 64 AV in your future. The key to this board's allure is its combination of low-cost and top-quality components: The Ultra 64 AV pairs the S3 Vision968 graphics/video accelerator with a top-notch 220-MHz TI TVP3026 RAMDAC and fast (60-ns) VRAM, giving it the ability to maintain VESA-compliant refresh rates in resolutions as high as 1,600-by-1,200 pixels.

The full-length board installs easily from DOS or Microsoft Windows 3.1x, but inexperienced users may encounter some rough spots. The company does not provide preset monitor selections—refresh rates must be individually selected for each resolution through the DOS- or Windows 3.1x-based AV Mode utility, and there's no mechanism to test the chosen rate.

The card's ability to support high refresh rates can be somewhat dangerous in this context; it's quite easy to select a rate that is damaging to older low-end monitors. In addition, under Windows 3.1x, changing the refresh rate causes the screen to blank out without warning. When the display returns, the new refresh rate has been correctly applied, but if you leave any programs open before you begin the process, changing the refresh rate closes them, and you lose any unsaved information within them.

The company provides drivers for an impressive list of CAD programs. Under Windows 3.1x, you get AV Mode, a screen-centering utility, and an "Information Center" that contains board-level data and listings for Actix's technical support, fax, and BBS numbers. There's no virtual display, no pan or zoom utility, and

no color-calibration facility, however. Actix bundles Xing's MPEG-player software with the board but at press time did not supply Video for Windows. You can download VFW 1.1e from the company's BBS. Under Windows 95, the board uses the generic S3 Vision968 drivers provided on the Windows 95 CD and Actix's DOS-based AV Refresh utility, which adjusts the refresh rate via command-line switches in your old AUTOEXEC.BAT.

A FEW PLUSES

Actix Systems has built some pretty decent components into the GraphicsEngine Ultra 64 AV. The board is user-upgradable to a full 4MB of VRAM, and the 220-MHz DAC provides a nicely saturated, flicker-free display. When we paired the card with a Nanao F2-17 monitor, it easily maintained a vertical

refresh rate of 100 Hz in 64,000-color mode at a resolution of 1,024-by-768 pixels—far beyond VESA's recommended 75 Hz. Thus, while the Ultra 64 AV's graphics performance numbers are less than stellar—the board fell squarely in the middle of the pack on virtually every

WinBench 96 and Winstone 96 test—the display is stable and free from artifacts. Video playback was on a par with the other S3 Vision968-based cards: The Ultra 64 AV won't bury your CPU with video tasks, but it also won't dazzle you with smooth-scaling interpolation routines.

The GraphicsEngine Ultra 64 AV combines top-flight hardware with barebones Windows drivers. It's not the fastest or fanciest board around, but its flicker-free display, impressive CAD-driver support, and low list price render it worthy of a careful look.—Jon Hill

GraphicsEngine Ultra 64 AV. List price: \$299. Actix Systems Inc., 3350 Scott Blvd., Bldg. 9, Santa Clara, CA 95054; 800-927-5557, 408-986-1625; fax, 408-986-1646.

Circle 441 on reader service card

Alaris Inc.

Matinee

Aimed primarily at the home computer user, the Alaris Matinee is, at \$299, a relatively affordable board. Unfortunately, the Matinee's lackluster graphics performance dulls the shine of its attractive price.

Based on a new chip from Alliance Semiconductor (the ProMotion 6410), the Matinee combines the Alliance chip with an AT&T PrecisionDAC (135 MHz) as well as 2MB of DRAM. It promises much in the realm of accelerated video playback with full-screen scaling. And when playing back unscaled 160-by-120-pixel video files in 640-by-480 screen resolution, it does do an impressive job, turning in scores near the top of the heap. Even scaling these small images up to full screen resulted in video playback with less noticeable pixelation and dropout than many of the S3-based boards demonstrated.

This board did rather well at 320-by-240, dropping only one frame; the CPU was higher than 80.7. On each test that we threw its way, this board consistently turned in solid video performances. And we were particularly impressed by the board's smooth handling of video scaling.



MORE OF THE SAME

Graphics performance did not equal the Matinee's video performance. The board always placed at or near the bottom of the test result. The board's redraw rate is noticeable at the higher resolutions, as would be confirmed by its low scores. With its low 24-bit Graphics WinMark



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CIRCLE 910 ON READER SERVICE CARD

Mainstream Accelerator Boards

score (4.77), this is definitely not a board to use with Photoshop.

Installation of both the board and the software was straightforward. The Alaris custom drivers are installed from Microsoft Windows 3.x (no Windows 95 drivers were available in time for our roundup) and provide quite a bit of control. Your monitor may be listed in the setup file, but if it's not, you can adjust all the parameters and then try it out. If your settings are not compatible with your display, you can stop the test and adjust the settings until they match your monitor's characteristics. Additionally, there are adjustments for vertical and horizontal positioning and a control for horizontal size. The drivers allow VESA-compliant refresh rates (75 Hz) in almost all available resolutions. However, it was unable to achieve a VESA-compliant refresh rate in 800-by-600 at 24-bit mode.

Construction of the board was good, although the VESA Feature Connector was placed close to—and perpendicular to—the mounting plate, an awkward location in the unlikely event you need to use it.

The Alaris manual is quite good. The pertinent company information is listed, and the descriptions of the software drivers accurately match those shipped. The manual is appropriately illustrated, and the only thing really lacking is a troubleshooting guide.

Ultimately, it is hard to recommend the Alaris Matinee for any reason other than price. The board doesn't deliver exceptional (or even acceptable) video playback, and it's a bit of a yawner when it comes to graphics performance. So unless you have an exceptionally tight budget, there are better boards available for a few dollars more.—Howard Alexander
Matinee. List price: \$299. Alaris Inc., 47338 Fremont Blvd., Fremont, CA 94538; 800-317-2348, 510-770-5700; fax, 510-770-5769.

Circle 442 on reader service

Asicom Inc.

Asicom Totem64V

Asicom's Totem64V PCI graphics accelerator board provides moderate graphics performance and impressive video performance at a modest cost.

Based on a Trident 9680 accelerator chip, the Totem64V lists for \$179 with 2MB of DRAM (\$279 with 4MB of DRAM). With average or better results on performance tests compared with other DRAM-equipped boards, the Asicom board is a competent but unexciting choice.

The Trident 9680 chip set (the only board we reviewed that uses it) does all the work of typically separate VGA BIOS, RAMDAC, and video acceleration chips as well as performing graphics acceleration. As a result, this board requires fewer parts than most others.

SOME OF THIS, SOME OF THAT

Software installation is a mixed story. The Microsoft Windows 3.1 display-driver installation software is a treat, running from Windows and making it easy to back out during the process to make changes. But a set of monitor utilities that includes screen centering must be installed and run from DOS. A Video for Windows 1.1e runtime is also included. The Totem64V's documentation consists of dry but informative generic manuals from Trident.

Once installed, the display-settings utility lets you change resolution, color depth, and refresh rate as well as make changes to the virtual display settings. On-the-fly refresh-rate switching is available when you are running in a virtual display mode. There's no refresh-rate test utility and no monitor-selection list.

Under Windows 3.1, the board maintained a VESA-compliant refresh rate of 75 Hz in 1,024-by-768 resolution at 8-bit mode. The board was unable to achieve a VESA-compliant refresh rate in 800-by-600 at 24-bit mode, however.

With 2MB of memory, this board runs at up to 1,600-by-1,200 resolution with 16 colors and supports 16.8 million 24-bit colors in 640-by-480 and 800-by-600 resolutions.

Asicom sent drivers for Windows 95, which installed correctly, but as we found with other boards in the roundup, they would support only a 60-Hz vertical refresh rate in 1,024-by-768 resolution, 16-bit mode. The supplied utilities didn't work with Windows 95. According to the vendor, drivers and utilities that work correctly with

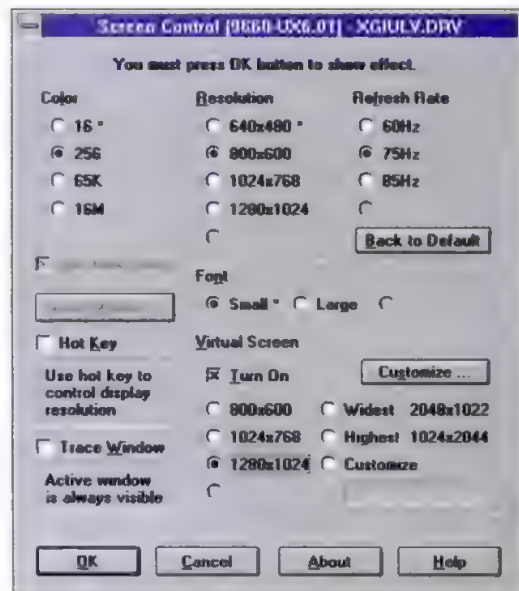
Windows 95 are expected by early 1996.

MIXED NUMBERS

When it came to performance testing, the Totem64V held its own against most other DRAM-based graphics boards. On Graphics WinMark testing, the Asicom board was among the fastest of the DRAM boards in

800-by-600, 16-bit mode; an above-average performer in 1,024-by-768, 8-bit mode; and about average for DRAM models in 800-by-600, 24-bit mode and 1,024-by-768, 16-bit mode. The board had average Winstone 96 scores compared with other DRAM boards.

For a bargain-priced board with an integrated accelerator and video chip, the Asicom board performed surprisingly



From Asicom Totem64V's Windows 3.1 Control Screen you can set color depth, resolution, and refresh rate.

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SUMMARY OF FEATURES

Mainstream Graphics Accelerators



	Actix Systems Inc. GraphicsEngine Ultra 64 AV	Alaris Inc. Matinee	Asicom Inc. Asicom Totem64V	ATI Technologies Inc. Winturbo	Cardexpert Technology Inc. Cardex Genesis/V PRO	Diamond Multimedia Systems Inc. Diamond Stealth64 Video 2201XL	Diamond Multimedia Systems Inc. Diamond Stealth64 Video 3200	Diamond Multimedia Systems Inc. Diamond Stealth64 Video 3240XL
■ YES ■ NO								
In alphabetical order by company								
List price	\$299	\$299	\$179	\$349	\$299	\$249	\$299	\$399
Bus types available	PCI	PCI	PCI	PCI	PCI	VL-Bus, PCI	VL-Bus, PCI	VL-Bus, PCI
Graphics accelerator chip	S3 Vision968	Alliance ProMotion 6410	Trident 9680	mach64	S3 Vision968	S3 Trio64V+	S3 Vision968	S3 Vision968
Includes video acceleration	■	■	■	■	■	■	■	■
Separate video-playback acceleration chip	None	None	None	None	None	None	None	None
VGA BIOS manufacturer	Phoenix	Phoenix	Trident	ATI	Phoenix	Quadtel	Quadtel	Quadtel
VGA pass-through connector	■	■	■	■	■	■	■	■
Hardware cursor	■	■	■	■	■	■	■	■
Display memory (tested configuration)	2MB VRAM	2MB DRAM	2MB DRAM	2MB VRAM	2MB VRAM	2MB EDO DRAM	2MB VRAM	2MB VRAM
Maximum installable memory	4MB	2MB	4MB	2MB	2MB	2MB	2MB	4MB
RAMDAC	TI TVP3026	AT&T PrecisionDAC	Integrated into Trident 9680	ATI-68860 SpectraDAC	IBM Palette DAC	Integrated into Trio64V+	TI TVP3026	TI TVP3026
Board uses DIP switches	■	■	■	■	■	■	■	■
Board uses jumpers	■	■	■	■	■	■	■	■
Board settings are configurable in an on-board EEPROM	■	■	■	■	■	■	■	■
Display Characteristics								
Maximum noninterlaced graphics resolution	1,600 x 1,200	1,280 x 1,024	1,280 x 1,024	1,280 x 1,204	1,600 x 1,200	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200
Maximum number of colors at:								
1,280 x 1,024	256	256	256	256	256	256	256	256
1,024 x 768	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
800 x 600 (Super VGA)	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
Software Drivers								
AutoCAD	■	■	■	■	■	■	■	■
Other CAD drivers	■	■	■	■	■	■	■	■
DCI	■	■	■	■	■	■	■	■
Microsoft Windows NT	■	■	■	■	■	■	■	■
OS/2 2.0	■	■	■	■	■	■	■	■
OS/2 2.1	■	■	■	■	■	■	■	■
Software Features								
On-the-fly resolution switching	■	■	■	■	■	■	■	■
Proprietary resolution-switching dialog box	■	■	■	■	■	■	■	■
Zoom	■	■	■	■	■	■	■	■
Virtual display	■	■	■	■	■	■	■	■
Refresh-rate selection utility	■	■	■	■	■	■	■	■
Environments	DOS, Windows 3.1	Windows 3.1	Windows 3.1	Windows 3.1, Windows 95	Windows 3.1	Windows 3.1, Windows 95	Windows 3.1, Windows 95	Windows 3.1, Windows 95
User can preview refresh rate	■	■	■	■	■	■	■	■
User can center screen image	■	■	■	■	■	■	■	■
User can change screen aspect ratio	■	■	■	■	■	■	■	■
Customer Support								
Technical-support phone number	408-986-1625	510-770-5700	800-354-0810	905-882-2626	510-252-1118, ext. 107	408-325-7100	408-325-7100	408-325-7100
Technical-support hours (eastern time)	11:00-9:00 M-F	10:30-8:30 M-F	12:00-9:00 M-F	9:00-7:00 M-F	11:30-9:00 M-F	9:00-5:00 M-Sat	9:00-5:00 M-Sat	9:00-5:00 M-Sat
BBS number	408-970-3719	510-770-5765	510-354-0905	905-764-9404	510-354-3800	408-325-7080	408-325-7080	408-325-7080
CompuServe	■	■	■	■ (GO ATITECH)	■	■ (GO DMNDONLINE)	■ (GO DMNDONLINE)	■ (GO DMNDONLINE)
Web page	■	■	■	■	■	■ (http://www.diamondmm.com)	■ (http://www.diamondmm.com)	■ (http://www.diamondmm.com)
E-mail address	None	support@alaris.com	totem64@aol.com	76004.3656@compuserve.com	102515.1150@compuserve.com	diamondts@aol.com	diamondts@aol.com	diamondts@aol.com
Warranty	2 years (parts and labor)	3 years (repair or replace)	Lifetime (parts and labor)	5 years (parts and labor)	3 years (repair or replace)	5 years (parts and labor)	5 years (parts and labor)	5 years (parts and labor)

N/A—Not applicable: The product does not have this feature

Continues

ELSA Inc. Winner 1000AVI	Focus Information Systems OptiView Pro	Focus Information Systems Premier 2000V	Genoa Systems Corp. VideoBlitz 3AV	Hercules Stingray 64/Video	Hercules Graphite Terminator Professional	Leadtek Research Inc. WinFast S250	Matrox Graphics Inc. MGA Millennium	Number Nine Visual Technology Corp. 9FX Motion531	Number Nine Visual Technology Corp. 9FX Motion771
\$329	\$219	\$229	\$289	\$259	\$389	\$237	\$379	\$249	\$329
VL-Bus, PCI	PCI	PCI	PCI	VL-Bus, PCI	VL-Bus, PCI	PCI	PCI	VL-Bus, PCI	VL-Bus, PCI
S3 Vision868	Alliance ProMotion 6410	ARK 2000PV	S3 Vision968	ARK 2000PV	S3 Vision968	S3 Vision868	MGA 2064W	S3 Vision868	S3 Vision968
None	None	IC Works ZoomDAC	None	IC Works ZoomDAC	None	None	None	None	None
Elsa	Phoenix	Ark Logic	Phoenix	Ark Logic	Phoenix	S3	Matrox	Number Nine	Number Nine
2MB DRAM	2MB DRAM	2MB DRAM	2MB VRAM	2MB EDO DRAM	2MB VRAM	2MB DRAM	2MB WRAM	2MB DRAM	2MB VRAM
2MB	2MB	2MB	4MB	2MB	4MB	2MB	8MB	2MB	4MB
S3 SDAC	AT&T PrecisionDAC	IC Works ZoomDAC	IBM Palette DAC	IC Works ZoomDAC	IBM Palette DAC	S3 SDAC	TI TVP3026	AT&T PrecisionDAC	IBM Palette DAC
1,280 x 1,024	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200	1,280 x 1,024	1,600 x 1,200	1,280 x 1,024	1,600 x 1,200	1,280 x 1,204	1,600 x 1,200
256	256	256	256	256	256	256	256	256	256
65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000
16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
Windows 3.1, Windows 95	DOS, Windows 3.1	DOS, Windows 3.1	Windows 3.1, Windows 95	DOS	DOS	Windows 3.1	Windows 3.1, Windows 95, Windows NT 3.5	Windows 3.1, Windows 95	Windows 3.1, Windows 95
408-565-9669	510-657-4586	510-657-4586	408-362-2990	800-323-0601	800-323-0601	510-490-8076	514-685-0270	617-674-0009	617-674-0009
11:00-8:00 M-F	12:00-8:00 M-F	12:00-8:00 M-F	11:00-8:00 M-F	9:00-9:00 M-F	9:00-9:00 M-F	11:00-10:00 M-F	8:30-6:00 M-F	8:00-6:00 M-F	8:00-6:00 M-F
408-565-9630	510-657-9451	510-657-9451	408-362-2999	510-623-7449	510-623-7449	None	514-685-6008	617-862-7502	617-862-7502
(GO ELSA)			(GO GENOA)	(GO) HERCULES)	(GO) HERCULES)		(GO MATROX)	(GO NINE)	(GO NINE)
(http://www elsa.com)							(http://www .matrox.com/ MGA)	(http://www .nine.com)	(http://www .nine.com)
None	None	None	71333.3543 @compuserve .com	support@ hercules.com	support@ hercules.com	leadtek@ interserv.com	graph_ts@ matrox .com	None	None
3 years (parts and labor)	1 year (repair or replace)	1 year (parts and labor)	2 years (parts and labor)	2 years (parts and labor)	5 years (parts and labor)	3 years (parts and labor)	3 years parts and labor)	5 years (parts and labor)	5 years (parts and labor)

SUMMARY OF FEATURES

Mainstream Graphics Accelerators

Ends

■ YES ■ NO In alphabetical order by company	Quadrant Components Inc. Astro 400	Spider Graphics Inc. Tarantula 64 MK.II	STB Systems Inc. Powergraph 64 Video	UMAX Technologies Inc. Maxmedia MG68D	Videologic Inc. GrafixStar 700
List price	\$220	\$275	\$229	\$199	\$249
Bus types available	PCI	VL-Bus, PCI	PCI	PCI	VL-Bus, PCI
Graphics accelerator chip	Weitek 9100	S3 Vision968	S3 Trio64V+	S3 Vision868	S3 Vision968
Includes video acceleration	■	■	■	■	■
Separate video-playback acceleration chip	Weitek Video Power 9130	None	None	None	None
VGA BIOS manufacturer	Weitek	S3	STB	Phoenix	S3
VGA pass-through connector	■	■	■	■	■
Hardware cursor	■	■	■	■	■
Display memory (tested configuration)	2MB VRAM	2MB VRAM	2MB EDO DRAM	2MB DRAM	2MB VRAM
Maximum installable memory	4MB	4MB	2MB	4MB	4MB
RAMDAC	Brooktree Bt489	Brooktree Bt485A	Integrated into Trio64V+	AT&T PrecisionDAC	IBM Palette DAC
Board uses DIP switches	■	■	■	■	■
Board uses jumpers	■	■	■	■	■
Board settings are configurable in an on-board EEPROM	■	■	■	■	■
Display Characteristics					
Maximum noninterlaced graphics resolution	1,600 x 1,200	1,600 x 1,200	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200
Maximum number of colors at:					
1,280 x 1,024	256	256	256	256	256
1,024 x 768	65,000	65,000	65,000	65,000	65,000
800 x 600 (Super VGA)	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
Software Drivers					
AutoCAD	■	■	■	■	■
Other CAD drivers	■	■	■	■	■
DCI	■	■	■	■	■
Microsoft Windows NT	■	■	■	■	■
OS/2 2.0	■	■	■	■	■
OS/2 2.1	■	■	■	■	■
Software Features					
On-the-fly resolution switching	■	■	■	■	■
Proprietary resolution-switching dialog box	■	■	■	■	■
Zoom	■	■	■	■	■
Virtual display	■	■	■	■	■
Refresh-rate selection utility	■	■	■	■	■
Environments	Windows 3.1	DOS, Windows 3.1	DOS, Windows 3.1, Windows 95	Windows 3.1, Windows 95	Windows 3.1, Windows 95
User can preview refresh rate	■	■	■	■	■
User can center screen image	■	■	■	■	■
User can change screen aspect ratio	■	■	■	■	■
Customer Support					
Technical-support phone number	510-252-6128	408-526-0535	800-234-4334	800-468-8629	415-875-0606
Technical-support hours (eastern time)	11:30-8:00 M-F	10:00-5:00 M-F	9:00-7:00 M-F	9:00-8:00 M-F	12:00-8:00 M-F
BBS number	None	408-526-1219	214-437-9615	510-651-2550	415-875-7748
CIS forum	■	■	■ (GO STBSYS)	■	■ (GO VIDEOLOGIC)
Web page	■	■	■	■ (http://umax.com)	■
E-mail address	quadrant@ix.netcom.com	spd@ix.netcom.com	None	support@umax.com	sales_usa@videologic.com
Warranty	5 years (parts and labor)	2 years (parts and labor)	Lifetime (parts and labor)	1 year (parts and labor)	5 years (parts and labor)

N/A—Not applicable. The product does not have this feature.

well on video testing, maintaining low frame-drop rates in both 1,024-by-728, 16-bit mode and 800-by-600, 24-bit mode. With few dropped frames, relatively low CPU utilization, and average or above-maximum frame rates on most tests, the Asicom is a good candidate for video applications. The only instances where the Totem64V didn't perform better than average was in 600- and 750-kilobits-per-second samples.

On subjective video testing the Asicom board appeared to be consistent at various image resolutions and frame rates, with little frame dropping noticeable until high data-transfer rates of 600 Kbps and 750 Kbps. Images appeared smooth on scaling tests until the 4X-scaling test, when some minor block smearing appeared along with noticeable frame drops. Even at full-screen mode, the image was viewable, if not pleasant, and certainly better than what we found with the ATI, Matrox, or S3 Vision968 video scalars.

The Totem64V is backed by a warranty and comes with toll-free technical support during weekday business hours.

Although it doesn't compete in performance with VRAM-based boards equipped with separate and speedy RAMDACs, the Trident-based Asicom Totem64V gives you better-than-average digital-video performance and good graphics abilities at a low price. —Bruce Brown

Totem 64V. List price: \$179. Asicom Inc., 46716 Fremont Blvd., Fremont, CA 94538; 510-354-0900; fax, 510-354-0909.

Circle 443 on reader service card

ATI Technologies Inc.

Winturbo

Although ATI Technologies' Winturbo graphics accelerator looks to be approaching the end of its life cycle, it still delivers better-than-average performance and flexibility in a variety of operating environments. With plenty of convenient features, acceptable unscaled digital-video performance, and a list price of \$349, the Winturbo remains a good choice for Microsoft Windows 3.1 and Windows 95 users alike.

The Winturbo is based on ATI's 64-bit mach64 controller and 135-MHz ATI-68860 SpectraDAC. The card comes with 2MB of VRAM and can reach a maximum

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Mainstream Accelerator Boards

resolution of 1,280-by-1,024 pixels with 256 colors and a 75-Hz vertical refresh rate. At the more common business-use resolutions of 1,024-by-768 at 16-bit color and of 800-by-600 at 24-bit color, it can achieve a near flicker-free 100-Hz vertical refresh rate.

In addition to the standard array of built-in accelerated Windows 3.1 functions, the Winturbo also performs XY interpolation for scaling video playback but does not do colorspace conversion scaling. Most popular compression algorithms are supported, including Indeo 3.2 and Cinepak. We also tested a preliminary copy of the company's software MPEG 1 player, which should be available by the time you read this.

The Winturbo also has built-in support for "virtual sprites." This technology allows animation screens to reuse common objects without redraws that can affect overall performance.

TURBO TIME

For users still committed to Windows 3.1, the Winturbo card offers a relatively effortless install and plenty of useful features. Its FlexDesk+ set of utilities enables you to change DPMS settings for power down, set the screen resolution and

virtual window size, change color depths, turn on dithering control, set the 256-color palette, and select hotkeys for panning and zooming. An included color-correction utility also allows you to set the white point, black point, and target gamma of your on-screen image.

On hands-on tests, all of these features worked well. The FlexDesk+ settings can all be changed without rebooting Windows, with the exception of color-depth changes. We also appreciated the contrast, brightness, and tint controls attached to the card's accelerated Video for Windows (VfW) driver (although we were disappointed to find that the runtime version of VfW was not included).

HANDLING 95

Windows 95 users will find that most of the important ATI utilities have already been implemented under the new OS. Under the display settings, ATI adds its own tabbed control panel, with screen size, position, and refresh-rate adjustments. Although it lacks the color controls and other little amenities found in the Windows 3.1 version, ATI plans to have a fully optimized, DirectDraw-enabled driver with all of the features added to its Windows 95 controls by the time you read this.

The Winturbo is an above-average performer for Windows 3.1 users. On application-load tests running multiple DOS and Windows 3.1 applications, everything ran smoothly. It also performed consistently error-free on our 800-by-600 and 1,024-by-768 Graphic WinMark and Winstone 96 tests.

The ATI card also delivered acceptable video playback in common 320-by-240 .AVI window sizes at 30 frames per second. It handled both Indeo and Cinepak files with equanimity.

On scaling and full-screen tests, the card dropped fewer frames than most, but visual quality was relatively poor.

Using the prerelease version of the company's MPEG player, we were also able to play back MPEG files smoothly in Windows 3.1 and Windows 95.

For a variety of standard business applications, the ATI Winturbo is neither the fastest nor the flashiest. But it is a solid Windows 3.1 performer, well suited to offices looking for a flexible graphics solution.—John R. Quain

Winturbo. List price: \$349. ATI Technologies Inc., 33 Commerce Valley Dr. East, Thornhill, Ontario, Canada L3T 7N6; 905-882-2600; fax, 905-882-2620.

Circle 444 on reader service card

Cardexpert Technology Inc.

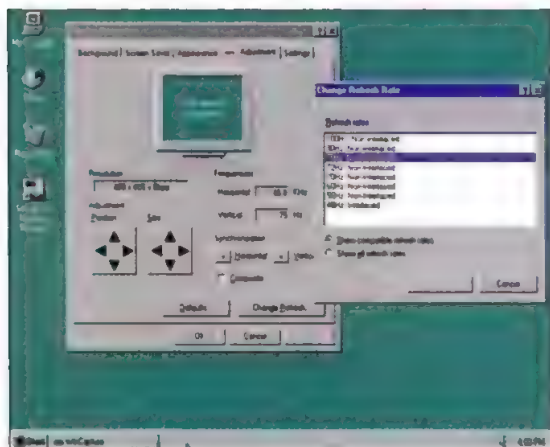
Cardex Genesis/V PRO

Like many cards tested in this roundup, the Cardexpert Cardex Genesis/V PRO is based on the S3 Vision968 chip set. This \$299 card put in a respectable performance, generally turning in slightly above-average benchmark scores on our testing.

Populated with 2MB of VRAM, Genesis/V PRO couples its S3 Vision968 chip with an IBM Palette DAC. Among its S3-driven peers, the Genesis/V PRO tended to put in a better-than-average video performance, often appearing in the top 20 percent. It exhibited a high frame-playback rate with a low CPU utilization and often (surprisingly) came close to the performance of the Weitek-powered Astro 400. But as was typical of the S3 Vision968 boards, the scaled video was nothing to rave about. Pixelation was quite noticeable when scaling the image size up, and there were momentary dropouts on the video playback as we changed the size of the display window.

IN THE MIX

Graphics performance was, as compared with the other Vision968 boards, middle of the road. But when viewed against all of the boards tested, the Genesis/V PRO generally performed just above average. Screen images were crisp, and there was no obvious redraw delay, even at the higher resolutions.



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Mainstream Accelerator Boards

The board appears to be well constructed and fit neatly into our test-bed machines. Software installation ran smoothly—though you must install the drivers in *both* DOS and Microsoft Windows (all are generic S3 drivers). Our one complaint about the DOS installation is that it defaults to loading the drivers into the root unless you specify a target directory. And even though you specify the directory, it is not added to the PATH statement in the AUTOEXEC.BAT.

Adjustment of the Windows 3.x resolution is provided by a nicely done applet. Controls for resolution, color depth, and refresh rate, as well as font size and DPMS parameters, are all available and can be stored as one of five presets. Once you have selected all the settings, you can

preview the new mode on your monitor. If all is well, you then restart Windows; if there's a problem you return to the applet and make the appropriate adjustments.

Almost all resolutions (except 1,600-by-1,200) were able to support the VESA 75-Hz refresh rate, but there's no provision for minor adjustments of horizontal and vertical scan rates as in some of the other S3-based boards reviewed here. In addition, it was unable to achieve a VESA-compliant refresh rate in 800-by-600 at 24-bit mode. The ability to center the image from the control panel would also be a nice addition. At press time, Cardexpert provided no specific driver for Windows 95, but it should be available by the time you read this. But the S3

chip is supported directly by Windows 95 (albeit with limited resolution and refresh rates).

Unfortunately, there's little good that can be said about the generic manual provided by Cardexpert. It is short, lacks contact information about the company, and provides no useful troubleshooting information. Should you have any problems with the Windows-based applet (there's no help file) the manual refers you to a READ.ME file but doesn't specify where it is. A detailed but somewhat confusing set of tables on the various graphics modes the card is capable of can be found in the manual. Speaking of trouble, we found various viruses infecting the four driver disks supplied to us. Cardexpert was informed of our findings.

Lifting the Silicon Veil

All graphics accelerator boards are *not* the same, but an awful lot of them *do* use the same chip sets. What you will notice as you peruse our brief Product/Chip matrix is that the majority of vendors use S3's popular VRAM-based

968 controller. Does this mean it's the best chip of the bunch? Not necessarily, but a look here should help you correlate performance patterns across multiple vendors and cards.

Basically, you shouldn't see two

cards using S3 Vision968s with radically different benchmark scores. On the other hand, many vendors have selected different DACs to couple with Vision-968; doing so may have some varying effect on resolution and refresh rate.

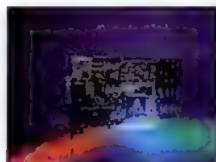
Chips On-Board

Underneath each chip set you can see a list of graphics boards that incorporate it. As our test charts show, different implementations may yield different results.



S3 Trio64V+

- Diamond Stealth64 Video 2201XL
- STB Powergraph 64 Video



Alliance ProMotion 641

- Alaris Matinee
- Focus OptiView Pro



S3 Vision868

- Leadtek WinFast S250
- Number Nine 9FX Motion531
- UMAX Maxmedia Graphic 880



ARK Logic ARK2000PV

- Hercules Stingray 64/Video



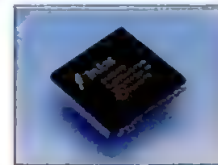
S3 Vision968

- Actix GraphicsEngine Ultra 64 AV
- Cardexpert Cardex Genesis/V PRO
- Diamond Stealth64 Video 3200
- Genoa VideoBlitz 3AV
- Hercules Graphite Terminator Professional
- Number Nine 9FX Motion771
- Spider Tarantula 64 MK.II
- VideoLogic GraficStar 700



ATI mach64

- ATI Winturbo



Trident 9680

- Asicom Totem64V



Matrox MGA 2064W

- Matrox MGA Millennium



Weitek 9100

- Quadrant Astro 400



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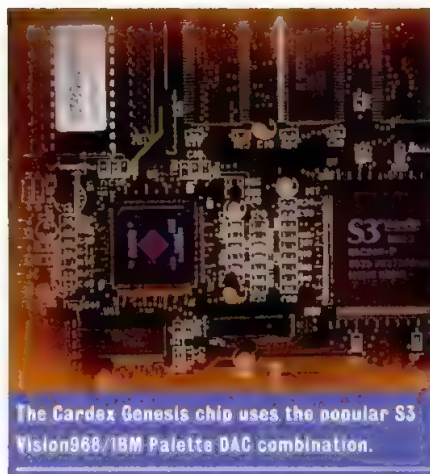
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PCs and Board-Bundle Deals Revealed

Your next graphics or multimedia accelerator most likely will come as part of the next PC that you buy or that your IS manager buys for you. With that in mind, we present a brief look at what boards and chip sets top PC vendors regularly bundle with their PCs. Remember, though, that the vendors supplied this information to us in October 1995, and bundle deals change as regularly as the weather.

The Board in Your PC

PC manufacturer and product	Installed graphics board or chip set
Acer America Corp.	
AcerAcros series	Diamond or STB
AcerPower series	Diamond or STB
AST Research Inc.	
Bravo LC	ATI mach64 or Trident 9440
Bravo MS	ATI mach64
Premia GX	Matrox Millennium
AT&T GIS	
Globalyst 300, 500, 600 series	S3 Trio64
Compaq Computer Corp.	
Presario 5528	S3 Trio64V+
Presario 7170, 7180	S3 Trio64
Presario 9546, 9548, 9564	S3 Trio64V+
Dell Computer Corp.	
Dimension XPS	S3 Trio64
Digital Equipment Corp.	
Celebris XL	Diamond Stealth64 or Matrox Storm
Starion	Matrox Millennium
Venturis 32	S3 Trio32 or S3 Trio64
Gateway 2000 Inc.	
All systems	STB Powergraph 64V or Matrox MGA Millennium; others on request
Hewlett-Packard Co.	
HP Vectra VE 4/ series	S3 Trio64
HP Vectra VE 5/ series	Cirrus Logic 5430
HP Vectra XM2 series	S3 B64
HP Vectra XU series	Matrox MGA Impression Plus
IBM PC Co.	
Aplica series	Trident 9680 XGI
Packard Bell Electronics Inc.	Info not available



The Cardex Genesis chip uses the popular S3 Vision968/IBM Palette DAC combination.

The Cardex Genesis/V PRO is reasonably priced, a decent performer that would be a good choice if you do primarily text and spreadsheet work. Although you can add additional VRAM (for a total of 4MB), there are better choices for graphics and video applications. —Howard Alexander

Cardex Genesis/V PRO. List price: \$299. Cardexpert Technology Inc., 47881 Fremont Blvd., Fremont, CA 94538; 510-252-1118; fax, 510-252-9889.

Circle 445 on reader service card

Diamond Multimedia Systems Inc.

Stealth64 Video 2201XL, Stealth64 Video 3200, Stealth64 Video 3240XL



Diamond Multimedia Systems has always known how to coax the most from the OEM chips that power its graphics cards. The three products reviewed here—the \$249 Stealth64 Video 2201XL, the \$299 Stealth64 Video 3200, and the \$399 Stealth64 Video 3240XL—compose a sophisticated product line with high graphics performance that is well suited for a range of consumer and corporate applications. The affordable 2201XL in particular blends solid graphics numbers with relatively efficient digital-video playback.

All three Diamond boards feature S3 chip sets. The 2201XL uses the economical S3 Trio64V+ and 1MB or 2MB of EDO DRAM (we tested 2MB). In addition

to a VESA Feature Connector, the 2201XL provides connectors for MPEG and TV-tuner ISA cards, both expected to be priced at around \$100. Bundled software includes CorelDraw 4.0 and Asymetrix's 3D/FX and Digital Video Producer.

Both the 3200 and 3240XL use S3's high-powered Vision968 chip. The lower-cost 3200 comes with 2MB of VRAM but offers a reduced software bundle and no expansion options beyond a VESA Feature Connector. The top-of-the-line 3240XL ships with the tested 2MB of VRAM, upgradable to 4MB, and features an MPEG daughtercard and the same software bundles offered with the 2201XL. Both boards use the same Texas Instruments TVP3026 DAC, with the



Diamond Stealth64 Video 2201XL minimizes the number of its components.

3200 tuned to 175 MHz and the 3240XL tuned to 220 MHz.

The three boards ship with Microsoft Windows 3.1, Windows NT, OS/2, and DOS drivers, and a functionally identical version of Diamond's InControl Tools graphics utility. Diamond also includes a Video for Windows runtime and MediaMatics software MPEG player with all products. Windows 95-native control utilities were not available for testing.

ENGAGING SOFTWARE

Windows 3.1 installation went smoothly for all boards, although the 3200 and 3240XL manuals don't mention the bundled Video for Windows or MPEG runtimes, a situation corrected in the newer 2201XL manual. All boards include presets for 76 monitors, and InControl Tools enables a User Definable monitor



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Mainstream Accelerator Boards

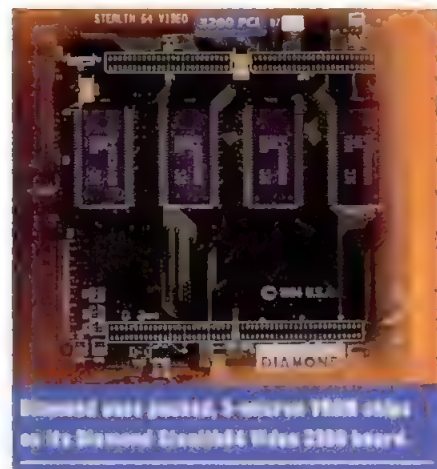
option (available in both DOS and Windows) to select resolutions and refresh rates with refresh-rate preview. Diamond's DOS installation program looks and runs like a Windows program and is very easy to use.

Diamond's InControl Tools has evolved into an extremely well-rounded utility. Highlights include virtual screen with auto centering, on-the-fly resolution changes, video-playback controls with display-rate testing, zoom in and out, a Display Power Management System and screen saver, an audio control panel, and color calibration with RGB, CMYK, and multiple test patterns.

HIGH-PERFORMANCE HARDWARE

Both the 3200 and 3240XL finished near or at the top on our WinBench 96 and Winstone 96 testing. Both boards also performed well on video playback tests, albeit with pixelation when zooming the video.

The Trio64V+-powered 2201XL beat



all similarly configured competitors quite handily and also rated highly against the field on most 16-bit, unscaled-video tests. Video benchmark tests were surprisingly good, easily surpassing the two Vision968-based Diamond products. On all video tests, including full-screen scaled playback, the 2201XL's scores were on a par with the top-performing scalars and video accelerators: the Alliance ProMotion 6410 and the Trident 9680.

Diamond's drivers also proved particularly stable. The 2201XL was one of the few boards to sail through our benchmark tests without crashing. Like



most boards reviewed, Diamond's other two boards required one or two test re-runs to complete benchmark testing but eventually completed them all. Diamond fared less well on Windows 95 testing, where the 2201XL was unable to achieve a noninterlaced refresh rate on our Micron P133 test-bed. Diamond should have a fix for this by the time you read this. All three boards performed well on our driver-torture tests, in which we load several Windows and DOS applications and attempt to crash the system.

Diamond's performance may in fact justify changing your purchasing decision from "whether Diamond?" to "which Diamond?" The two Vision968-powered boards, with rock-solid, big-screen refresh rates, are ideal for graphics-intensive applications such as desktop publishing and virtually all general-purpose programs. The 3200 is the inexpensive, stripped-down option, while the 3240XL offers expandability to 4MB of VRAM, MPEG, and a useful software bundle, making it one of the more attractive boards in this evaluation. The low-cost 2201XL may be the steal of the roundup, coming in with very strong graphics and video performance, MPEG- and TV-expansion options, and three useful software programs.—Jan Ozer

Stealth64 Video 2201 XL. List price: \$249. **Stealth64 Video 3200.** List price: \$299. **Stealth64 Video 3240XL.** List price: \$399. Diamond Multimedia Systems Inc., 2880 Junction Ave., San Jose, CA 95134-1922; 408-325-7000; fax, 408-325-7070.

Circle 446 on reader service card

ELSA Inc.

Winner 1000AVI

With a list price of \$329, the ELSA Winner 1000AVI is the most expensive S3 Vision868-based board we tested. What sets this board apart from its brethren, as well as many of the other boards in this roundup, is its remarkable assortment of software and drivers.

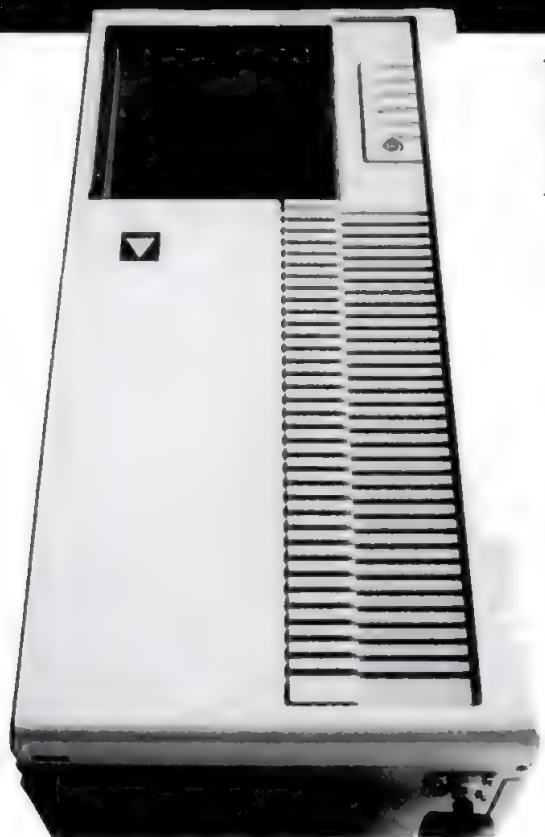
As was typical of the Vision868-based boards, the Winner 1000AVI generally scored below average on video-frame rates and higher than average on both dropped frames and CPU utilization. It turned in its best performance with files that were 320-by-240, 30 frames per second, with a 300-Kbps data rate when in the 1,024-by-768 at 16-bit mode. When playing back video in the 800-by-600 at 24-bit mode, its performance was consistent with or slightly better than two other Vision868 boards. When using the included Xing MPEG player, we were able to get decent MPEG playback.

The Winner 1000AVI was also generally below average on our benchmark testing, though its Winstone 96 results were the best for any of the Vision868 boards. On the Winstone 1024-by-768 at 8-bit test, it actually scored higher than several of the S3 Vision968-based boards. We attribute this to ELSA's long history of driver-optimization expertise.

EASY START

With the exception of the somewhat flimsy bracket, the board is well constructed. An S3 SDAC (135 MHz) as





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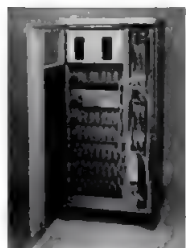
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well as four DRAM chips (for a total of 2MB) can be found on the board. We had no real problem with the physical installation of the card. All drivers for the card come on both disk and CD-ROM. For users of CAD, particularly AutoCAD, ELSA supplies a very powerful and flexible Windows-based accessory, Powerdraft. For the average user, ELSA offers a wealth of utilities and adjustment tools.

During setup (all Windows based) you have the opportunity to select your display from a list of about 150 monitors; if it's not there then you can literally "design" an appropriate setup. The selection of parameters can be intimidating, but the flexibility is quite impressive. Fortunately, you can test your settings before committing to them.

Other applets supplied by ELSA include a mode switch, virtual screen display, DPMS controller, a program launcher, a display-characteristics status program, as well as a full copy of LEAD-view (a \$399 desktop publishing package). We also received a driver for Windows 95. The board was not recognized initially by the operating system, but after a manual installation everything worked fine. WINman, the program for modifying and switching modes, works in the Windows 95 environment. Full support for the VESA refresh rates (75 Hz) was available for all resolutions.

The manual, which is in both German and English (and covers another product as well), could use a bit more work. While it goes into great detail on the CAD drivers, it leaves you somewhat stranded on the initial display setup, by referring you to help screens in the program that are occasionally cryptic.

The real strength and attraction of the Winner 1000AVI lies in its support for the CAD user. And it offers a wide range of utilities and programs. But its price is actually higher than some of the VRAM-based display cards that offer significantly better performance.

—Howard Alexander

Winner 1000AVI. List price \$329. ELSA Inc., 2041 Mission College Blvd., Suite 165, Santa Clara, CA 95054; 800-272-3572, 408-565-9669; fax, 408-565-9650.

Circle 447 on reader service card

Focus Information Systems Inc.

OptiView Pro Premier 2000V

Give Focus Information Systems some credit: Their two submissions for this roundup are forward-looking products that provide low-cost, accelerated video playback and acceptable overall graphics performance. The OptiView Pro (\$219) and Premier 2000V (\$229) appear at first glance to be similar, but the two boards rely on vastly different architectures. Unfortunately, neither product completely delivers on its potential: Nagging problems place these DRAM-based offerings a couple of notches below the top boards in this roundup.

Both boards use a combined DOS and Microsoft Windows 3.x installation—you begin under DOS, and after installing the meager utilities, you're prompted to switch to Windows to continue the process. The OptiView Pro comes with DOS-based refresh-rate adjustment and test facilities, and a nicely designed Windows 3.1x control panel that lets you set resolution, color depth, and refresh rate. The Premier 2000V adds virtual display under Windows 3.1x but is otherwise similar. Focus provides Windows 95 drivers, but the versions we received provided bare-bones chip support and no added utilities.

TO GET THE JOB DONE

The Optiview Pro relies on the Alliance ProMotion 6410 single-chip multimedia accelerator for all of its core functionality. The 6410 provides hardwired support for standard graphics primitives (such as bit-BLTs, pattern fills, linedraws, polygons, and clipping routines) and adds what Alliance calls "no-cost motion video" support in the form of colorspace conversion, X and Y scaling, and interpolation in both axes. The chip manipulates video data in its native YUV format, sectioning off a portion of the standard frame buffer to

store video information off-screen before converting it on the fly to RGB format and sending it to the board's AT&T PrecisionDAC for display. While the board could achieve 75 Hz at most resolutions and color depths, it couldn't do the same in 800-by-600 at 24-bit mode.

The Premier 2000V takes a completely different tack. Its ARK2000PV accelerator is a fairly standard graphics chip, providing virtually no direct support for video acceleration. But the chip

does support EDO DRAM, providing higher throughput than standard page-mode DRAMs. But this board does not take advantage of this capability: The Premier 2000V uses standard DRAM. Focus has, however, paired the rather ordinary ARK2000-PV with an extraordinary chip, IC Works' ZoomDAC.



Unlike standard digital-to-analog converters, the ZoomDAC contains built-in video zoom circuitry. The chip can take a 160- by 120-pixel video window, filter the image to provide 24-bit-video quality while in 8-bit graphics mode, enlarge it up to full screen, and interpolate the result to provide a smooth final image to your monitor.

THE REALITY

Unfortunately, we encountered some problems with both approaches. The OptiView Pro consistently occupied the bottom third of our WinBench 96 and Winstone 96 rankings. In particular, it performed poorly in 24-bit-color mode at 800-by-600 pixels, finishing dead last among the boards in this roundup. Its video performance was excellent, with one major exception: When any portion of a graphics window (for example, the Media Player control bar) is superimposed on a video window, the video-playback rate declines considerably and image quality degrades noticeably. Essentially, the board cannot handle a clipped video window.

The Premier 2000V performed poor-

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Mainstream Accelerator Boards

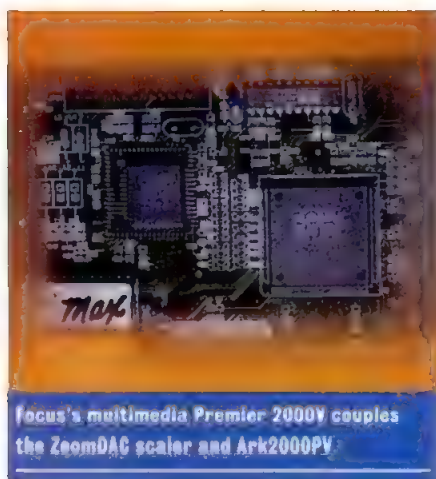
Genoa Systems Corp.

VideoBlitz 3AV

Genoa Systems Corp.'s \$289 VideoBlitz 3AV combines workmanlike performance in both graphics and video with a hefty helping of utilities. Based on S3's Vision968 graphics accelerator chip and an IBM 64-bit RAMDAC, the 2MB VRAM-based VideoBlitz 3AV supports DPMS energy-saving modes and includes a Video for Windows 1.1e runtime module, Xing's MPEG player, and a fun Popeye screen saver. The MPEG player runs .MPG files, but there were many frame drops in full-screen scaling and at 50 percent of original size.

Windows 95 drivers were not ready in time for our story but should be available by the time you read this. The board also comes in a 4MB version (\$399).

The Windows 3.1 drivers and Propilot—Genoa's own graphics utility software—install from Windows. During installation, the DPMS utility is installed and turned on without notifying the user, a feature you may not appreciate. You can use Propilot to set refresh rates for your monitor, but there are no preset monitor configurations within the Windows software. You should appreciate the clear, profusely illustrated manual that comes with the VideoBlitz 3AV and the manual for Propilot.



ly on our WinBench tests, joining its sister board in the bottom third of the pack, but its Winstone scores were generally very good. The graphics display quality is adequate in 8-bit mode, but it's unacceptably blurry in 16-bit or 24-bit color. The Premier 2000V also had some real problems displaying video. During anecdotal testing, the OptiView Pro suffered a precipitous decline in playback rates when we clipped the video window with a graphics object: A significant number of frames were dropped from our test file, and CPU utilization on our 133-MHz Pentium was an unacceptable 99.6 percent. Additionally, serious artifacts marred the display. Graphics objects placed over the video window got zoomed along with the video, and the mouse cursor skated to the edges of the window.

While both the OptiView Pro and the Premier 2000V have their share of flaws, street prices for these cards are likely to dip below \$200. If you're not overly concerned with graphics performance, and you're looking for a decent low-cost video-playback card, the Alliance ProMotion-based OptiView Pro may fit the bill. The Premier 2000V will give you better overall graphics performance, but its poor visual quality in high- and true-color modes, coupled with its curious video artifacts, limit its utility.—Jon Hill

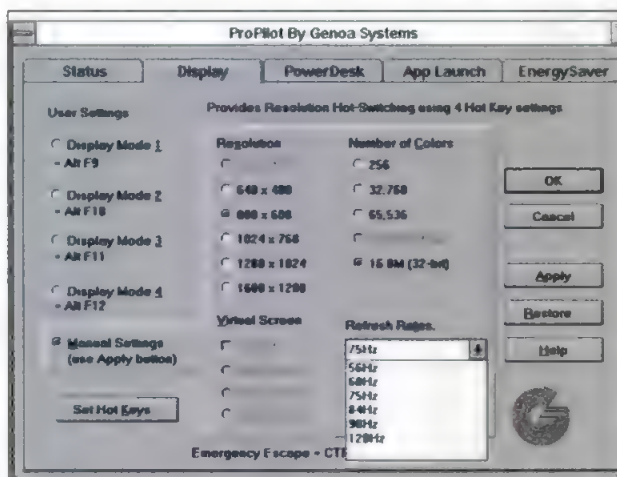
OptiView Pro. List price: \$219. **Premier 2000V.** List price: \$229. Focus Information Systems Inc., 48860 Milmont Dr., Suite 108C, Fremont, CA 94538; 800-925-2378; fax, 510-657-4158.

Circle 448 on reader service card

SHARPER IMAGE

The maximum supported resolution with 2MB memory is 1,600-by-1,200 at 256 colors and 72 Hz, an excellent range for business users but not professional graphics users.

Thanks to the high-speed IBM 64-bit RAMDAC, the board runs at or above VESA-supported refresh rates for both 800-by-600 and 1,024-by-768 resolutions. In 1,024-by-768 mode, the maximum settings are 64,000 colors and 84 Hz, and you can run up to 90 Hz with 16.8 million colors in 800-by-600 mode. This was especially



Genoa System's Propilot graphics utility, supplied with the VideoBlitz 3AV, uses a tabbed interface for setting the display configuration and for accessing and controlling other utilities.

noteworthy because there was a handful of boards that were able to achieve 75 Hz only in one testing mode.

The Propilot utility lets you change resolution, color depth, and refresh rates from a pick list. Propilot is loaded with helpful extras such as virtual-desktop size switching, a thumbnail screen that shows your relative position on the virtual desktop, pan and locking controls, Windows dialog-box centering, zoom control within the supported resolutions, password access for the screen saver, and hotkeys for launching Windows applications.

The Propilot utility does not feature any monitor presets, and it lets you pick refresh rates far beyond your monitor's ability—but doing so will make the image unviewable and may harm your monitor if you're not careful. An upgraded Propilot with refresh-preview ability should be available by the time you read this.

The VideoBlitz 3AV did very well on benchmark performance testing, especially

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Mainstream Accelerator Boards

on the Graphics WinMark tests, where it was one of the fastest boards in 800-by-600 at 16-bit and at 1,024-by-768 at 8-bit and 16-bit. In all three cases, it trails only the Diamond Stealth64 Video 3200 and 3240XL boards. In 800-by-600 resolution at 24-bit, the VideoBlitz 3AV also made a strong showing. On Winstone 96 application testing, the VideoBlitz 3AV was an average performer.

The Genoa board showed its stuff well on video testing, performing at or close to the level of the fast Diamond Stealth64 Vision968-based boards on many tests, with very low frame-drop rates, high maximum-frame rates, and low CPU utilization. The only tests in which the Genoa, like many of the other Vision968-based boards, did not do well on were our full-screen-scale tests, where its scores dropped like a rock.

As with other S3 Vision968-based boards, video scaling is weak for the Genoa board. Scaling a 160-by-120 digital-video clip, for example, produces much choppier video and more dropped frames than playing the clip at its native window size.

On subjective video testing the Genoa board looks smooth on most tests until scaling gets to 4X normal, when frame dropping becomes obvious, though the pixels are still pretty smooth. In full-screen mode frame dropping increases, plus you see increased posterization and block smearing.

The VideoBlitz 3AV is backed by a two-year warranty and toll-call technical support during weekday business hours. It still has a few rough edges, yet it's a reasonably priced board with respectable graphics performance that may be worth a second look.

—Bruce Brown

VideoBlitz 3AV. List price: \$289. Genoa Systems Corp., 6850 Santa Teresa Blvd. San Jose, CA 95119; 800-934-3662; fax, 408-362-2968.

Circle 449 on reader service card

Hercules Computer Technology Inc.

Stingray 64/Video, Graphite Terminator Professional

Hercules has built some comfort into its Stingray 64/Video (\$259) and Graphite Terminator Professional (\$389) accelerators, but neither product is built for speed. Both boards come with an

improved set of utilities for Microsoft Windows 3.x, and the Terminator Professional's 220-MHz IBM Palette DAC provides a rock-steady display, but these



boards came up short on some of our performance tests.

Both boards "feature" a combined DOS and Windows 3.x setup routine that is needlessly complex. Each installation begins under DOS. That lets you decompress the DOS-based refresh-rate utilities and Windows 3.x drivers and run the monitor-selection program. After choosing a monitor from an admirably long list of supported models, the program modifies your AUTOEXEC.BAT file to set the refresh rates. Then you close Windows, start it up again, and run Window's own setup program from the Control Panel. After selecting the proper display driver, you need to reboot to set the refresh rate and start Windows 3.x again to begin using the new drivers and utilities.

Windows 95 support was meager at the time of this roundup, but we were able to set the Stingray's Windows 95 refresh rate with the card's DOS utility, and the Terminator Professional's driver negotiated a decent refresh rate via Windows 95's monitor .INF files.

Hercules bundles Xing's MPEG player and a nicely designed set of Windows 3.x utilities with both cards. In addition to Picture Window, which lets you set the resolution and color depth, the company provides a Refresh Rate Meter that displays the current refresh rate, a wallpaper selection utility, and two little video-oriented gems: PowerPreview and PowerPlayer. If you've ever tried to search through a long list of video files to find the one you want

to play, you'll appreciate PowerPreview. The program lets you quickly browse through directory trees, displaying thumbnail-size single-frame depictions of each .AVI file, and you can play the entire file via the Power Player utility directly from within Power Preview.

TAKING A CLOSER LOOK

When we paired the Terminator Professional with a Nanao F2-17 monitor and tested the card's refresh rate, we were in for quite a shock. Hercules's Refresh Rate Meter read 150 Hz at a resolution of 640-by-480 pixels in 24-bit color; we verified that result with a hand-held Extron meter. The board was able to sustain admirably high refresh rates to a resolution of 1,280-by-1,024 pixels, where the board tops out at 85 Hz. On the top-flight Nanao monitor, the display was crisp and clean, with vivid colors and no discernible flicker.

Unfortunately, the Terminator Professional performed poorly on our WinBench 96 and Winstone 96 tests. The card managed average WinBench performance at 1024-by-768 pixels in 256-color mode, but ranked last or next to last among its S3 Vision968-based peers at every other resolution and color depth, and its Winstone results were nearly as poor. Video perfor-



mance was on a par with other Vision968-based boards, generally the lowest-scoring group in the roundup.

The Stingray had a nearly identical graphics performance profile, but the Stingray's 256-color performance is quite good, and its ZoomDAC can take advantage of this by displaying true-color video within a 256-color graphics stream. The ZoomDAC also provides the Stingray with first-rate video-playback perfor-

Gateway 2000



Portable PCs



I needed out. My buddies in the programming lab were getting to me. So I tossed my Gateway Solo™ S120 Best Buy multimedia notebook into my pack and headed for the desert. Nothing like a little hot earth to clear the mind.

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There I was. Miles from anywhere, just working away. Thinking — *man, I love this machine!* Everything I need, right at my fingertips. A powerful 120MHz Intel® Pentium® processor, active matrix SVGA color display, 16MB RAM, whopping 1.2GB hard drive, and CD-ROM drive — it's high-end desktop power in a portable PC.

Perched on a rock, jamming to my favorite tunes (thanks to the 16-bit sound stereo speakers and CD-ROM drive), I watched the moon begin its journey across the night sky.

Off in the distance I saw headlights and heard the whining of an engine begging for a tune-up. Soon a battered old truck screeched to a halt in front of me. Over the dull roar of honky-



GATEWAY2000
S O L O

tonk music I heard, "Need a lift buddy?" Sure, why not.

"My name's Ned. And this here's Chuck."

He gestured to the armadillo curled up next to him. "I'm in 'crete." 'Crete? "Yea, lots of

opportunity in concrete. Spend a lot of time on the road. But I like it that way. Say you got yourself a pretty nifty Gateway 2000® notebook.

Me too. Wouldn't make a move without Sally here," Ned smiled as he patted the

Gateway Solo V75 notebook sitting on the dash. Sally? "That's what I call her, after a certain waitress in Tucson," Ned winked at me. "Sally's loaded. She has a 75MHz



Gateway Solo notebooks are optimized for Microsoft® Windows® 95.

Pentium processor, 8MB RAM,

540MB hard drive, and CD-ROM drive." He winked at me again.

Ned named his portable Sally.

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EZ Pad™ pointing device for easy cursor navigation.

"I'm mighty fond of Gateway 2000. Best values in portable PCs around," smiled Ned. "And their portable line has something for everyone."

**More co
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The radio droned on as Ned, Chuck and I continued on our trek through the dark desert.

Armadillos like to have their heads rubbed. At least Chuck did. Up ahead I saw the neon sign of a roadhouse — a beacon in the darkness.



"I could use some grub. How 'bout you?" asked Ned as he pulled the truck into the dirt parking lot.

There she stood in all her glory. Tiara and satin dress shimmering beneath the fluorescent lights. "Next tour's in 15 minutes, honey," she said. Tour? "My name's Delilah, and I give the best moonlit desert tours in the West. Is that a Gateway

computing, places.

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note-
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she asked
eyeing my portable.



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mere 4.2 pounds! Why, this glorious PC has won nearly as many awards as I have! And the best part," Delilah leaned in closer. "Its

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"The *best* darn tours
in the West!"

huge 10.4-inch color screen is dual-scan for extra privacy." I suppressed the urge to ask the Desert Queen about the secrets she was keeping from the world.



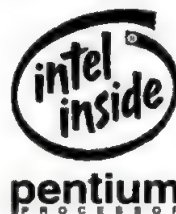
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believe that each system gets 24-hour, seven-day-a-week technical support? And their values just can't be beat," said Delilah with a far off look in her eyes. I had a feeling my adventures were just beginning.

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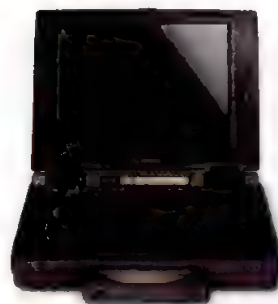
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Mainstream Accelerator Boards

mance: Its scaling engine delivered high frame rates and low CPU-utilization numbers on nearly every test. Whenever we forced the board to clip the video display by partly obscuring the playback window with a graphics object, however, the playback rate dropped precipitously and the CPU utilization on our 133-MHz Pentium test-beds rose to nearly 100 percent.

These two products were something of a disappointment. Hercules virtually invented the original PC graphics display, but that was over ten years ago. The best things about these cards are the Power Preview and Power Player utilities, which work with virtually any hardware. As a low-cost entry into video-enhanced computing, the Stingray 64/Video is not a terrible choice, but be prepared to tolerate some unusual effects. The Graphite Terminator Professional provides a much more stable platform, but the Vision968-based card offers little to recommend it over the other boards in its price range.—Jon Hill

Stingray 64/Video. List price: \$259.
Graphite Terminator Professional. List price: \$389. Hercules, 3839 Spinnaker Ct., Fremont, CA 94538; 800-532-0600, 510-623-6030; fax, 510-623-1112.

Circle 451 on reader service card.

Leadtek Research Inc.

WinFast S250

Despite the promise of high performance, the Leadtek WinFast S250 does not even come close to living up to its name. While reasonably priced at \$237, the board ends up a disappointment. One of three S3 Vision868-based boards we reviewed, the S250's performance was a disappointment. On some tests it scored well below the ELSA Winner 1000AVI and Number Nine 9FX Motion531, the other two S3 Vision868 cards.

When it comes to video playback, the WinFast S250's test results showed it to be less than the ideal choice for multimedia. Frame rates were below average, while CPU utilization and frame-drop rates were often significantly higher than the norm. Surprisingly, the unit performed best in the 1,024-by-768 at 16-bit mode. We initially had problems running our video tests, since we received neither a DCI driver nor Video

for Windows from Leadtek. The board did come with Xing's MPEG player software, but the performance was unacceptable until we were able to load the DCI driver software. Scaled images, as was typical of most of the other Vision868-based boards tested, had no-



ticeable pixelation, and the greater the magnification factor, the greater the frame drop.

NOT SO FAST

As for graphics performance, here, too, the WinFast S250 didn't distinguish itself. With the exception of the Graphics WinMark 1,024-by-768 at 8-bit results, its performance was consistently below the average. The two other S3 Vision868 boards had similar performance. Output to the monitor is supplied by an S3 SDAC.

The well-built board fit neatly into our test system's PCI slot. DOS utilities—including refresh-rate adjustment, mode set, and DPMS—are installed from a generic DOS-based program—but not automatically added to your AUTOEXEC.BAT. The same program also offers a wide range of CAD drivers. Microsoft Windows 3.x drivers are loaded from within Windows itself. We were not supplied with Windows 95 drivers (they were not yet available), but the Windows 95 upgrade disk does have a generic driver for the S3 Vision868 chip set.

The board was able to meet the 75-Hz VESA spec at all resolutions. We did notice one odd feature in the display adjustment applet: Not only could you change the resolution, refresh rate, and color depth (effective after rebooting Windows), but you could also enable or disable the DCI driver.

Further investigation showed that DCI was not available for all combinations of resolutions, color depths, and refresh rates. The company acknowledged the limitation but could offer no explanation.

The generic manual, lacking pertinent company contact information, had a plethora of interesting but not germane details. It should have forgone the esoteric in favor of a better description of the function of the Windows 3.x control applet. There's far more detail about installation for Windows NT than for Windows 3.1, and little description of the applet's function. The addition of a troubleshooting section would be a good idea.

It would seem that the performance limitations of the WinFast S250 are largely due to its S3 chip set. If you're looking for Windows-based graphics and video performance, look elsewhere.—Howard Alexander

WinFast S250. List price: \$237. Leadtek Research Inc., 46721 Fremont Blvd., Fremont, CA 94538; 510-490-8076; fax, 510-490-7759.

Circle 452 on reader service card

Matrox Graphics Inc.

MGA Millennium

Matrox Graphics' MGA Millennium (\$379) features robust graphics performance, top-flight 3-D acceleration, an intuitive set of Microsoft Windows 3.1x utilities, and some of the most complete Windows 95 support we've seen to date.

The card's 220-MHz TVP3026 DAC and fast WRAM give it the ability to support very high refresh rates, yielding a nicely saturated, flicker-free display. The MGA does a relatively poor job of scaling and interpolating video playback, so if video is your top priority, you may want to consider adding one of Matrox's Media XL daughtercards: one with MPEG support (\$349) or the one we tested, which doesn't support MPEG (\$249). But for other tasks it's hard to go wrong with the Millennium.

The card ships with a complete set of drivers for OS/2 Warp, Windows 95, Windows NT 3.51, and Windows 3.1x. Matrox adds a CD containing on-line documentation, a color calibration facility, Video for

15°

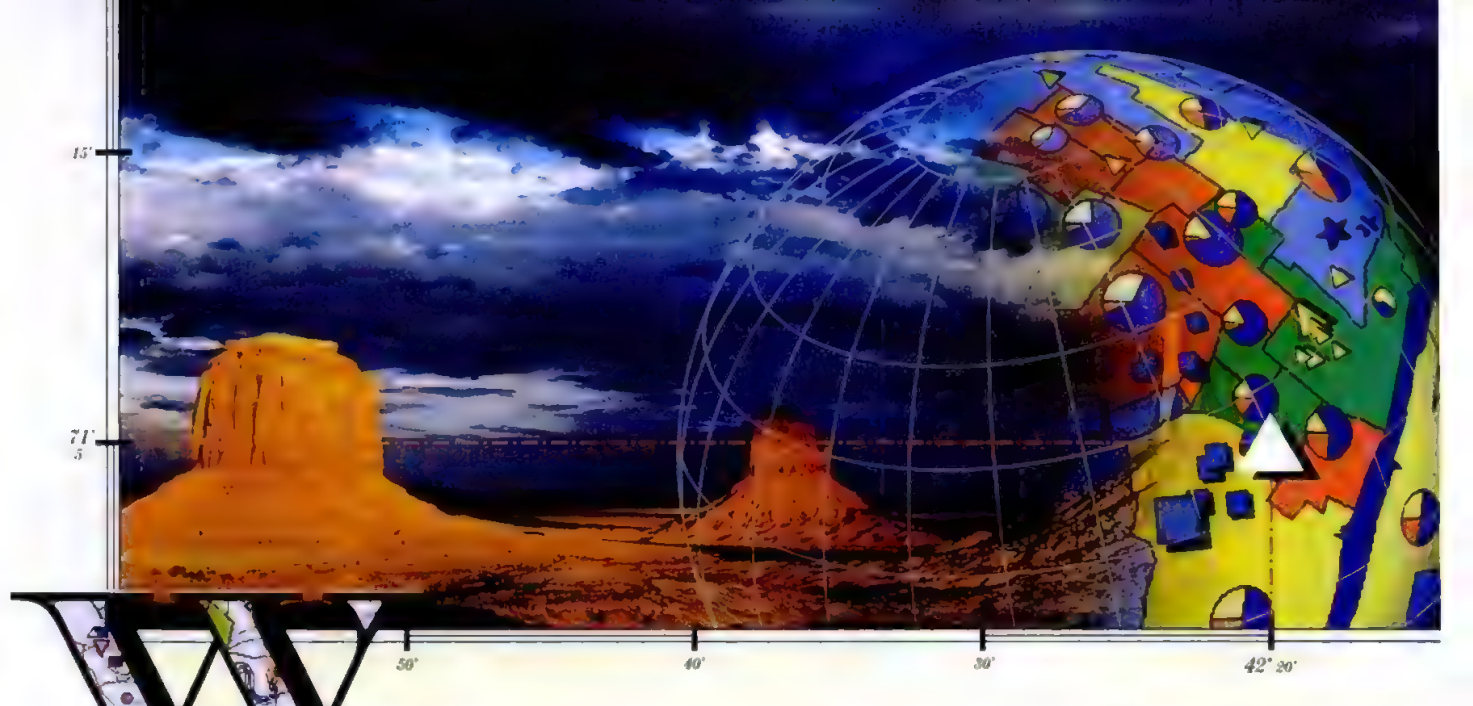
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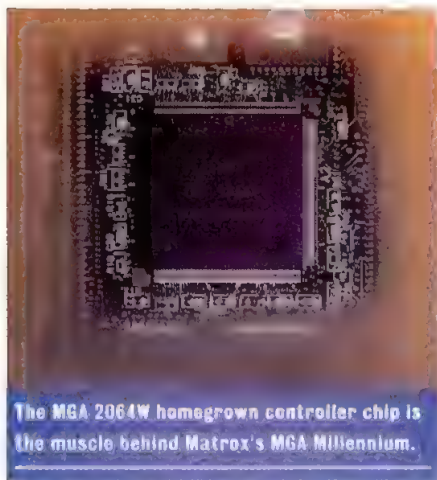
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UNLEASHING THE POWER OF GEOGRAPHY

Mainstream Accelerator Boards

Windows 1.1d, CompCore's softPEG Player for MPEG-1 playback, Asymetrix 3D F/X, and Papyrus's NASCAR racing game to this mix. Matrox made its reputation supporting the CAD market; its 2-D-



The MGA 2064W homegrown controller chip is the muscle behind Matrox's MGA Millennium.

and 3-D-CAD driver support and productivity enhancements are among the best in the business; the company remains one of very few vendors to supply DLP-based (Display List Processing) drivers for AutoCAD for Windows, AutoCAD for DOS, and MicroStation.

ENTERING THE MILLENNIUM

Installing the board's Windows 3.1x drivers was a snap, and the Plug and Play-ready Millennium's Windows 95 installation was even easier. Under Windows 3.1x, you simply run the card's setup routine from Program or File Manager, select a monitor file, and the setup routine does the rest. The Monitor Selection Utility allows you to test and configure the card's refresh rate for each resolution. The list of supported monitors is small, but you can create a custom monitor file, select a compatible monitor from the list, or use supplied generic monitor profiles.

You can use the same method to choose a monitor under Windows 95, but the Millennium's support for Windows 95's monitor .INF files is easier and far more powerful. If you selected your monitor properly when you installed Windows 95, the Millennium sets the refresh rate in accord with your selection. If you change the Windows 95 monitor selection, under the Windows 95 Display Settings control panel, the card adjusts the refresh rate.

Once installed, under Windows 3.1x the MGA Control Panel includes ModeSwitch (can swap through resolution and color-depth combinations on the fly); PixelTouch (zooms); MaxView (sets maximized windows to visible desktop size); CenterPopUp (sends message windows to center of visible desktop); and the ability to customize some advanced display driver settings.

In addition to enabling or disabling advanced acceleration functions such as polygons and rectangles, the Millennium has three preset acceleration profiles that optimize for standard Windows use, AutoCAD for Windows, or 3-D acceleration. MGA Quick Access provides one-button access to several Control Panel functions, including virtual display, ModeSwitch, and PixelTouch. The company's Windows 95 utilities meld nicely with the OS's Display Properties utility via an additional folder tab. The Millennium's functions have survived the upgrade intact, and even more complete Windows 95 support including DirectDraw and DirectVideo should be available by the time you read this.

BENCHMARKED

The Millennium is a first-rate 2-D graphics accelerator, and MGA-series chips remain the only ones currently available to combine 2-D and 3-D acceleration chips on a single chip. On our Winstone 96 tests, the board was the top performer at both 16- and 24-bit color depths, but the board's WinBench 96 scores were somewhat disappointing, if still among the top third.

Our video tests revealed the Millennium's weakest point. While the board's DCI drivers worked ad-

mirably—the card did not drop frames or cause audio breaks on any unscaled video playback test—the MGA-2064W chip does not provide interpolated scaling support. Our jury ranked the MGA's scaled-video quality near the bottom, tied with ATI's mach64 and IC Work's ZoomDAC, but in fairness, other supposedly video-enabled chips did nearly as poorly on this test.

The MGA Millennium can be upgraded via a daughtercard to a total of 4MB or 8MB WRAM, and the company plans a TV-tuner option for the MediaXL. The extra memory opens up the card's 3-D capabilities significantly. The 2MB board that we tested functions quite well on general-purpose Windows tasks, however, and the Millennium's bundled software, intuitive features set, and Windows 95 support all point to a hearty recommendation.—Jon Hill

MGA Millennium. List price: \$379. Matrox Graphics Inc., 1025 St. Regis Blvd., Dorval, Quebec, Canada H9P 2T4; 800-361-1408; fax, 514-969-6363.

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Call DirectX: Multimedia Games Get Windows' Number

By Jan Ozer and Larry Seltzer

It's ironic that the character-based world of DOS has always provided an environment far superior to Windows 3.1 for playing highly graphical and multimedia-rich games.

Because it's the parent to both the operating system and the environment, nowhere was this irony more keenly felt than in the halls of Microsoft. As whispers about the next revision of Windows began, the idea of removing and—ultimately—supplanting DOS took hold. Microsoft developers knew they had to make Windows 95 the predominant gaming platform.

Of course, this meant opening the channels between applications and hardware, a pathway that had always been available to DOS. Direct communication between games and devices such as sound cards, joysticks, and graphics accelerator boards is nothing new to the character-based OS.

That DOS applications communicate directly with hardware components means DOS gamers enjoy fast and efficient action. Unfortunately, it also means that each application must contain specific drivers for each hardware device, an increasingly difficult burden for developers. In contrast, Windows 3.x virtualized the computer, directing all application-peripheral communications through Windows' Graphics Device Interface (GDI) or a similar application programming interface (API). This eliminated the need for apps to provide device-specific drivers but created a level of administrative overhead that slowed performance dramatically. It also prevented Windows applications from accessing hardware-acceleration features on graphics cards, including 3-D and digital video playback acceleration.

IS SPEED ENOUGH?

As processors got faster, the performance of common applications like

spreadsheets or word processors became acceptable. But for graphics-, video-, and audio-intensive applications like games, performance under Windows 3.1 still lagged far behind DOS.

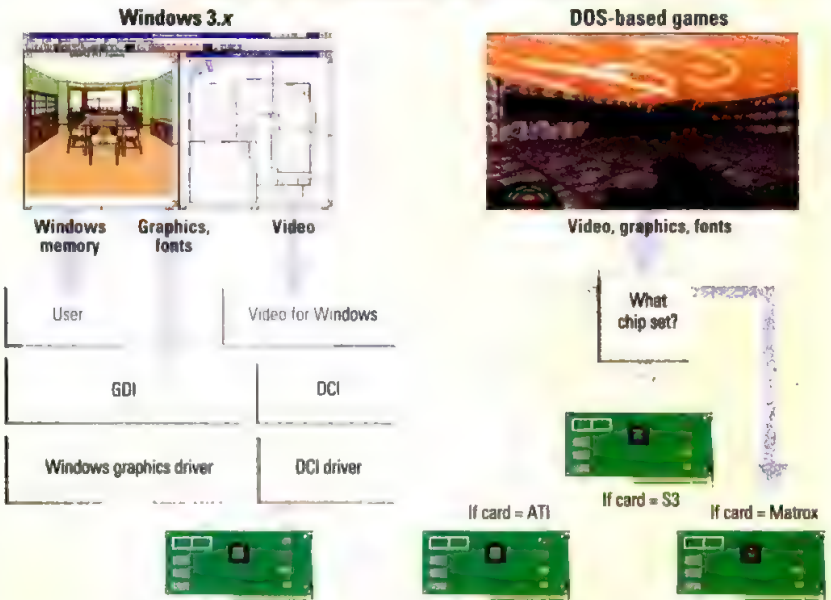
Likely spurred by the proliferation of CD-ROM drives and CD-ROM disks filled with multiple flavors of digital video, Microsoft's first swipe at the problem addressed only motion video performance. Microsoft introduced Video for Windows, a video file format and API that stimulated the growth of video development tools and video usage under Windows 3.1.

DCI also created a structure for polling individual graphics accelerator cards to identify advanced video-related functions such as scaling or YUV (which represents luminance and chrominance)-to-RGB conversion. While a precise figure is obviously application- and computer-dependent, DCI has generally been attributed with boosting video playback performance under Windows 3.1 by upwards of 30 percent.

To support the new standard, codec and graphics card developers had to update or develop new Win-

Before Direct Access

Games have traditionally avoided Windows' graphics facilities, because games need much faster graphics than GDI provides. By accessing the hardware directly, games get the performance they need but lose the hardware independence that Windows apps enjoy.



To address performance, Microsoft joined forces with Intel to develop and introduce the Display Control Interface (DCI). This was the first Windows-based technology that let digital video streams bypass Windows' GDI and directly access the video frame buffer on graphics cards that supported video acceleration.

dows drivers, but DCI support was transparent to the application developer, as long as it supported Video for Windows. If both the codec and the graphics card supported DCI, the codec wrote to the video frame buffer; if not, video was routed through GDI.

continues

Critics
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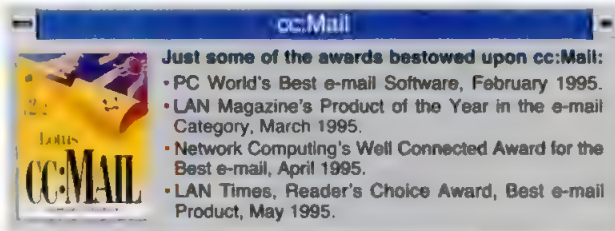


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Call DirectX: Multimedia Games Get Windows' Number, continued

3-D ENVY

DCI was extremely successful, garnering broad support from both the codec and graphics card communities. Unfortunately, despite improved video playback performance, Windows still fell behind DOS in other key areas like graphical animation, where DOS programs directly access graphics hardware and Windows applications don't.

To achieve their goal of establishing Windows 95 as a world-class game platform, Microsoft developers had to extend the direct access afforded via DCI to other multimedia elements. This was the intent behind DirectDraw, DirectSound and DirectInput, new specifications finalized by Microsoft this past September and released in the Windows 95 DirectX SDK in October.

DirectDraw goes beyond DCI to provide direct access to graphics hardware for operations such as blitting, support for color-space conversion, and color-keying. DirectSound provides direct access to audio hardware for the mixing of multiple audio streams and hardware acceleration of audio playback. DirectInput provides direct access to analog- and digital-joystick hardware to enhance the responsiveness of these peripherals.

All three programming interfaces replace the virtual device drivers that previously connected the application with the peripheral, but only when both support the Direct specification. Like DCI, DirectSound and DirectInput are completely backwards-compatible, meaning that the system defaults back to the virtual device drivers without loss of functionality when the new spec isn't available under the app or hardware.

In contrast, DirectDraw isn't backwards-compatible with

DCI. Neither DCI nor DirectDraw were available for the shipping version of Win 95, so apps have no direct access to features such as digital video scaling and YUV-to-RGB conversion, and video playback performance degrades in many instances to pre-DCI levels. These functions should be restored once a DirectDraw driver for the graphics card and DirectDraw apps such as Video for Windows 95 are installed.

DirectDraw calls are designed to look and operate like direct graphics and video hardware calls, just in a device-independent way. Developers who have been writing directly to hardware should find the DirectDraw model similar to what they have been following under DOS, except that they will no longer need to branch calls for the different hardware types they support;

DirectDraw does it for them.

DirectDraw also lets the program determine whether a particular hardware feature—such as hardware-based digital video stretching and interpolation—is available or whether software emulation should be used instead.

In addition, DirectDraw emulates a linear video memory model for the application for video hardware components (typically, older SVGA cards) that do not have linear memory, although the performance hit for this emulation can be considerable. This is done through a virtual device driver (VxD) via page faults.

OPEN THE APIS, DAVE

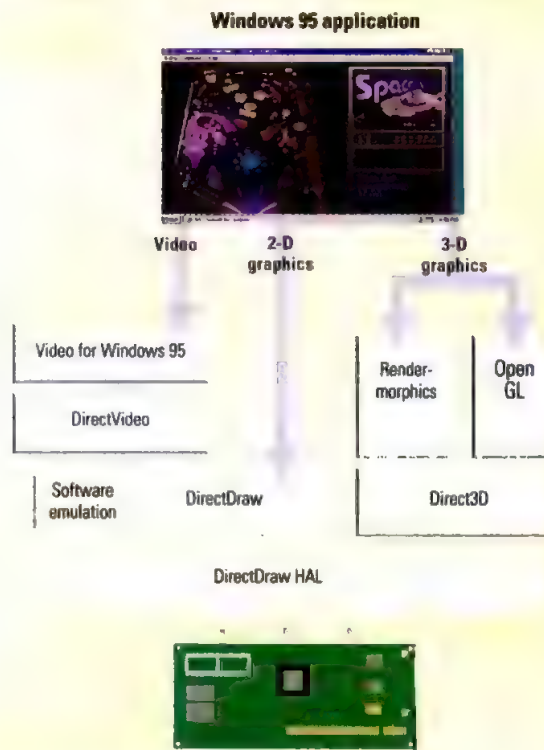
Another advantage of DirectX APIs, especially DirectDraw as compared with DCI, is that DirectDraw drivers are easy to write. The hardware vendor writes a DirectDraw HAL (Hardware Abstraction Layer), a thin device driver for translating DirectDraw's device-independent hardware access into the specific calls for its hardware.

There's a separate but analogous driver for 3-D acceleration. The 2-D application interfaces with DirectDraw, either with DirectDraw calls or through Video for Windows. 3-D applications make calls to the Rendermorphics or OpenGL APIs, which in turn make Direct3D calls.

DirectDraw, DirectInput, and DirectSound will likely be incorporated in future builds of Windows 95. But for now they will be distributed by games developers with their titles, along with drivers for graphics cards, sound boards, and joysticks. To take full advantage of the new specs, you must get the appropriate driver, either through a games developer or the peripheral manufacturer.

Using Windows 95's Direct SDK Access

DirectDraw, by providing a thin layer of abstraction over direct hardware acceleration features, gives games high performance and device independence as well as access to other Windows 95 features.



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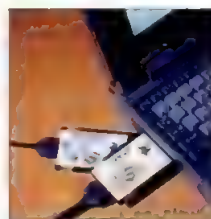
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Mainstream Accelerator Boards

Number Nine Visual Technology Corp.

9FX Motion531, 9FX Motion771

Notable for their superior features and utilities, the two versatile Number Nine graphics adapters reviewed here represent a two-pronged approach to meeting Windows users' needs. The \$249 9FX Motion531 is the company's entry-level Windows accelerator for users who have occasional 24-bit color needs, while the \$329 9FX Motion771 is a performance-oriented adapter for those who need higher resolutions and a little more speed.

As the bargain-priced accelerator, the 9FX Motion531 is founded on a 64-bit S3 Vision868 chip and a 135-MHz AT&T RAM-DAC. Rather than using expensive VRAM or EDO DRAM, however, the card relies on 2MB of less-expensive DRAM. Consequently, it can achieve a top resolution of only 1,280-by-1,024 pixels with 256 colors and a 75-Hz vertical refresh rate. In 1,024-by-768 mode, the board can display up to 65,000 colors with a 78-Hz refresh rate, and in 800-by-600 mode up to 16.7 million colors can be displayed with a refresh rate of 76 Hz.



Number Nine's 9FX Motion531 also uses the more compact 0.5-micron DRAM.

STILL SHARP

For Microsoft Windows 3.1 users upgrading their systems, the 9FX Motion531 offers an easy installation routine and the company's HawkEye utilities. The software includes preset resolution settings for 160 different monitors, a runtime version of Video for Windows 1.1d, and a software MPEG decoder. No full-scale applications are included, though.

The HawkEye controls are still some of the most extensive available in this category. Most helpful are its virtual screen controls, which allow you to double the height or width of the image as well as center windows and dialog boxes. You can even change the size and color of the

hardware cursor. Of course, you also can adjust the screen position, refresh rate, and resolution on the fly. To change color depth, though, you'll have to reboot Windows 3.1.

For Windows 95 users, Number Nine has duplicated all these software controls in the new operating environment. All the new utilities appeared to work as well as the previous versions, including Color-Perfect color-correction controls that let you make adjustments in gamma, RGB, or CMY colorspaces.

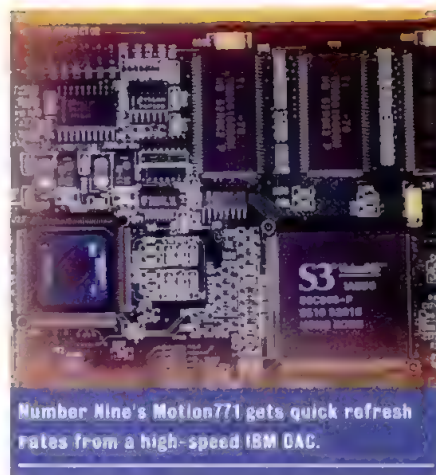
The Motion531 had no trouble negotiating typical video window playback sizes but dropped more frames than most when

we scaled a 160-by-120 pixel Indeo .AVI file. It couldn't produce acceptable Indeo full-screen-scaled video playback and tended to fall behind on our long-Indeo-clip test and drop more frames than the majority of boards we tested.

On Windows 3.1 performance tests, the Motion531 was an able performer in 800-by-600 resolutions—unless the color requirements were raised. When using 16.7 million colors in SVGA mode, for example, it slowed perceptibly.

9FX MOTION771

For \$80 more, business users will probably be happier with the 9FX Motion771's performance. It's based on a 64-bit S3 Vision968 accelerator with a fast 220-MHz IBM Palette DAC and 2MB of more expensive VRAM. For the additional money, you get higher resolutions, up to 1,600-by-1,200 pixels with 256 colors and an ergonomic 83-Hz vertical refresh rate. However, true color support is still limited to 800-by-600 mode, albeit with a higher maximum refresh rate of 150 Hz. (A 4MB VRAM version is available for \$499, and its utilities also run under Win-



Number Nine's Motion771 gets quick refresh rates from a high-speed IBM DAC.

dows 95.) Better still, the Motion771 includes all the same utilities supplied with the 9FX Motion531 card.

For flat-out Windows 3.1 speed, the Motion771 is one of most consistent performers in this roundup. It managed to place in the top six on nearly all the Graphic WinMark tests and held onto its position on most WinStone application tests.

For multimedia work, the 9FX Motion771 card managed 30-frame-per-second Cinepak and Indeo clips in 320-by-240 window sizes with aplomb. It was also more adept than most of the cards in scaling playback Window sizes up to four times their original size. But like the majority of cards based on S3's Vision968

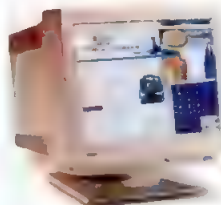


In its Windows 95 utilities, Number Nine Visual Technology gives you zoom control as well as extra tab panels under the Display utility to change colors, resolutions, and virtual screen size.

chip, it struggled with scaled full-screen Indeo file playback.

For home computer users, Number

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Max Resol.	1600 x 1200 @ up to 66Hz
On Screen Control	ScreenManager™ and ScreenManager™ Pro
Standards	MPR-II, TCO

T2-17Ts	
Aperture Grill	0.25mm
Actual Viewing Diag.	16.0"
Scan Freq.	H:30-96kHz, V:55-160Hz
Res. Resol.	1280 x 1024 @ up to 82Hz
Max Resol.	1600 x 1200 @ up to 66Hz
On Screen Control	ScreenManager™ and ScreenManager™ Pro
Standards	MPR-II, TCO

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Mainstream Accelerator Boards

Nine's 9FX Motion531 is a solid low-cost graphics adapter with Windows 95 smarts. More demanding business users will find the 9FX Motion771 more their speed, and it comes with the same flexible utilities that make the Motion531 so easy to live with.—*John R. Quain*

9FX Motion531. List price: \$249. **9FX Motion771.** List price: \$329. Number Nine Visual Technology Corp., 18 Hartwell Ave., Lexington, MA 02173; 800-438-6463, 617-674-0009; fax, 617-674-2919.

Circle 454 reader service card

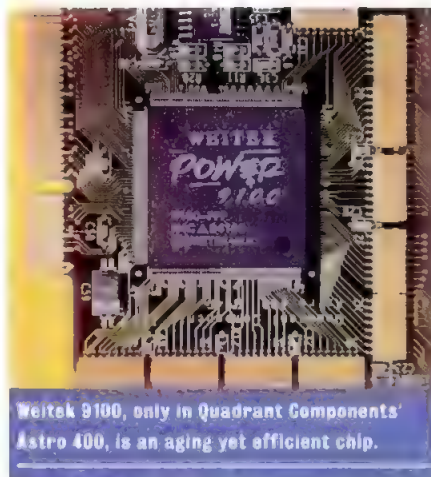
Quadrant Components Inc.

Astro 400

If any one word could be used to sum up the performance of Quadrant's Astro 400, that word would be *extreme*. With a list price of \$220, this reasonably priced board lives up to its name with truly stellar video playback performance. Unfortunately, its graphics performance is rather earthbound.

Based on Weitek's two-chip set (the 9100 for display/graphics, and the 9130 Video Power for video playback/acceleration), the Astro 400 routinely outperformed the competition when playing back video clips. Scaling the image size up resulted in a picture with very few of the distortions we've come to accept reluctantly with digital video. The video had little pixelation; curves tended to be smooth and display a minimum of stair stepping; and the demand for CPU resources was minimal. Though the Weitek 9130 is an aging chip set with a relatively uncertain future, it clearly set the standard for digital video playback performance early on. Surprisingly, it clearly still has an edge, and might be an even more powerful performer on a board that didn't run the 9130 at 45 MHz, 5 MHz below the liable spec.

This performance is due largely to the fact that the scaling engine processes (both interpolation and proprietary processing) the image on both the x and y axes, while most of the other controllers interpolate in the x axis and replicate (repeat) along the y. Also, thanks to the dedicated video processor, there was no noticeable dropout of the video if you moved the play window (scaled or unscaled) around the screen.



TWO-FACED

Where the Weitek chip set excels at video playback, the same hardware is also to blame for the Astro 400's lackluster graphics performance. Although the board utilizes VRAM (it comes with 2MB but can be upgraded to 4MB), the aging 9100 chip set has a 32-bit interleaved structure—most of the other boards here are 64-bit. Results from the benchmarks consistently indicate performance that is below average, sometimes significantly so. In actual use, we were aware of screen redraw when running at higher resolutions.

Installation of the card and its drivers is fairly simple. The Microsoft Windows 3.x drivers install from within Windows, and there's a generic applet (supplied by Weitek) for changing resolution, color depth, and refresh rate. All resolutions (except for 1,600-by-1,200) can support the VESA refresh rate of 75 Hz. Windows must be restarted whenever you make a change in the display settings. The list of monitor presets is around 100, but we were unable to find one for our test system's Magnavox monitor and were forced to match the board's output modes with the display on our own.

Although the display applet lets you optimize the board's performance for either video or graphics, we didn't notice any significant improvement. Several other options exist for fine-tuning the video performance. Unfortunately, the generic manual (with no company name or contact information) does not discuss any of these advanced features. Although the units we received did not include drivers for Windows 95, they should be avail-

able by the time you read this.

Reasonably well constructed, the board mounted on our test bench without difficulty. In addition to the Weitek 9100 (and the 9130 mounted directly under, on the bottom of the board) a Brooktree Bt489(170-MHz) RAMDAC is used. Our tested board was not upgradeable, though the company states that future versions will feature that option.

If digital video looms large in your future, the Astro 400 is definitely worth consideration. The price is right and the video performance is excellent. But if you're looking for powerhouse graphics performance, keep on walking.—*Howard Alexander*

Astro 400. List price: \$220. Quadrant Components Inc., 4378 Enterprise St., Fremont, CA 94538; 510-656-9988; fax, 510-656-2208.

Circle 455 on reader service card

Spider Graphics Inc.

Tarantula 64 MK.II

A reasonably priced and capable entry in this roundup, the Spider Graphics Tarantula 64 MK.II is a well-rounded if not top-drawer card. In its 2MB configuration, it carries a list price of \$275 while managing to deliver most of the same features available from other graphics cards in this roundup.

Spider's graphics accelerator is based on the popular 64-bit S3 Vision968 graphics accelerator chip coupled with a 135-MHz Brooktree RAMDAC. The model we tested included 2MB of VRAM, although a 4MB version is available for approximately \$350, or users can upgrade





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PARADISE
Western Digital Corporation



Benchmark Tests: Mainstream Graphics Accelerators

While most vendors have graphics performance under Windows 3.x figured out, acceptable full-screen, digital video playback is still something of a work in progress.

What the Numbers Mean

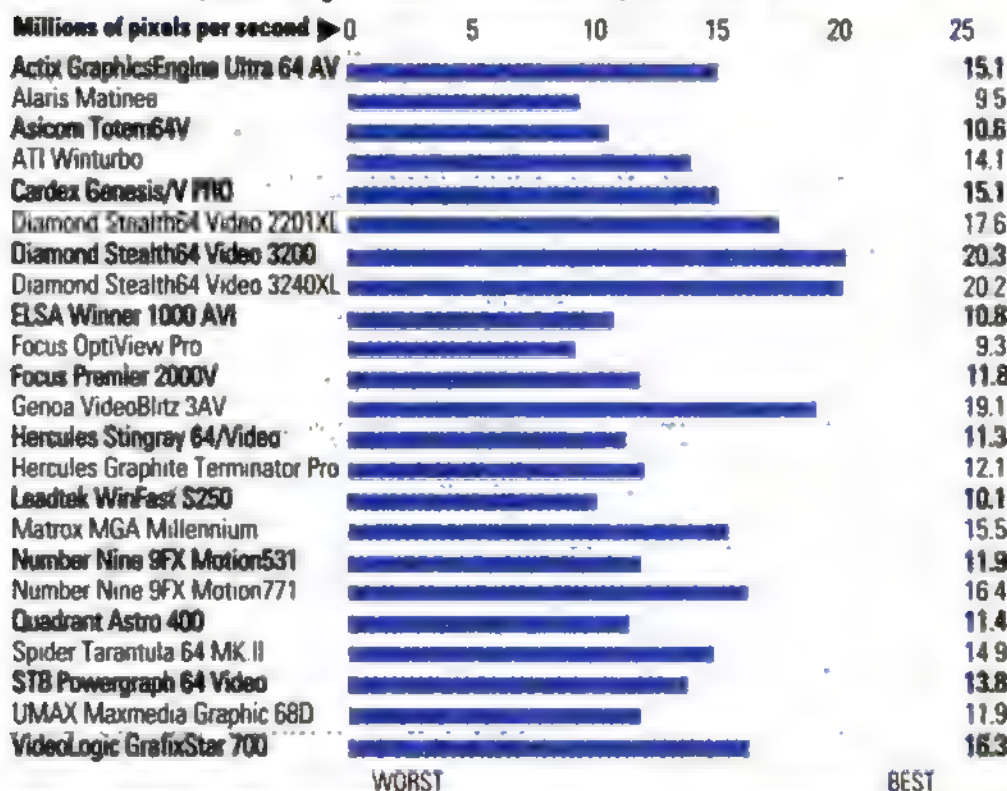
In raw graphics performance, the VRAM-based Diamond Stealth64 Video 3240XL was at or near the top of many of our Winstone and WinBench tests. Using the S3 Vision968,

this board surpassed many of the other VRAM entries on WinBench at all resolutions and color depths, except for its nonupgradable sibling, the Diamond Stealth64 Video 3200, which it almost tied with on a few scores.

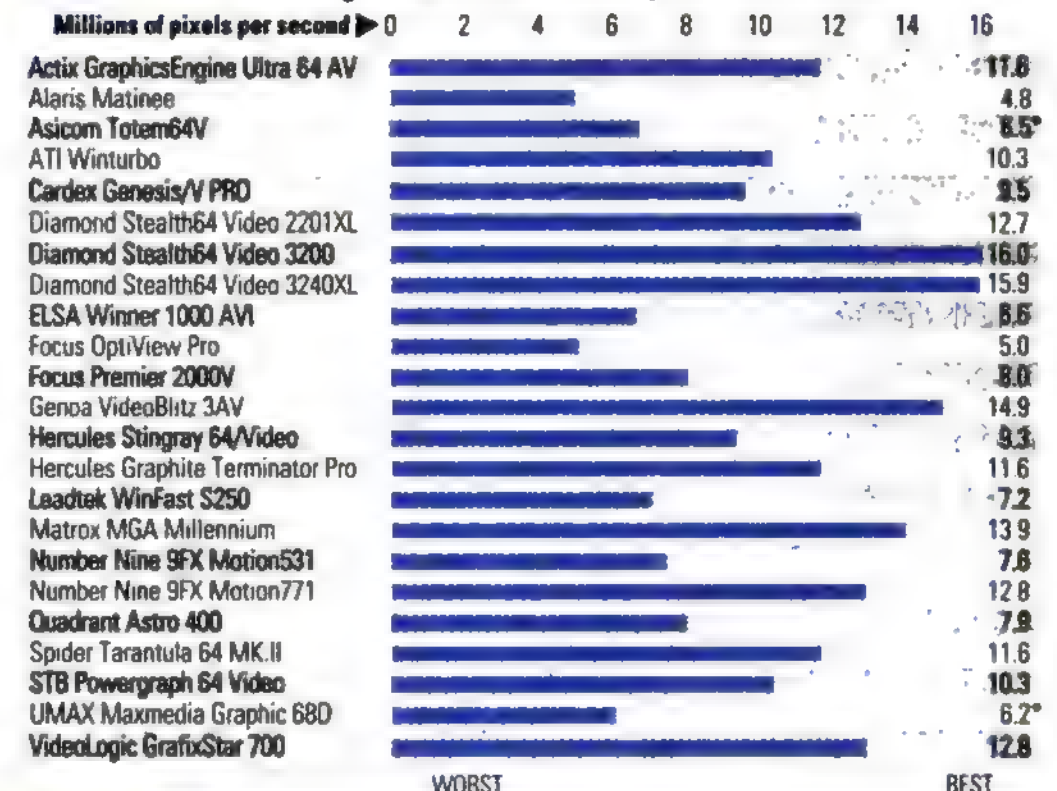
The Matrox MGA Millennium took the number one position, outperforming the Diamond Stealth64 Video 3240XL on our Winstone tests at 16- and 24-bit color depths. The low-cost Trio64V+ chip on the EDO DRAM-based Diamond Stealth64 Video 2201XL and the STB Powergraph 64 Video (also using EDO DRAM) both surprised us either by beating some of the VRAM boards

GRAPHICS WINMARK 96

1,024-by-768 resolution, 16-bit color

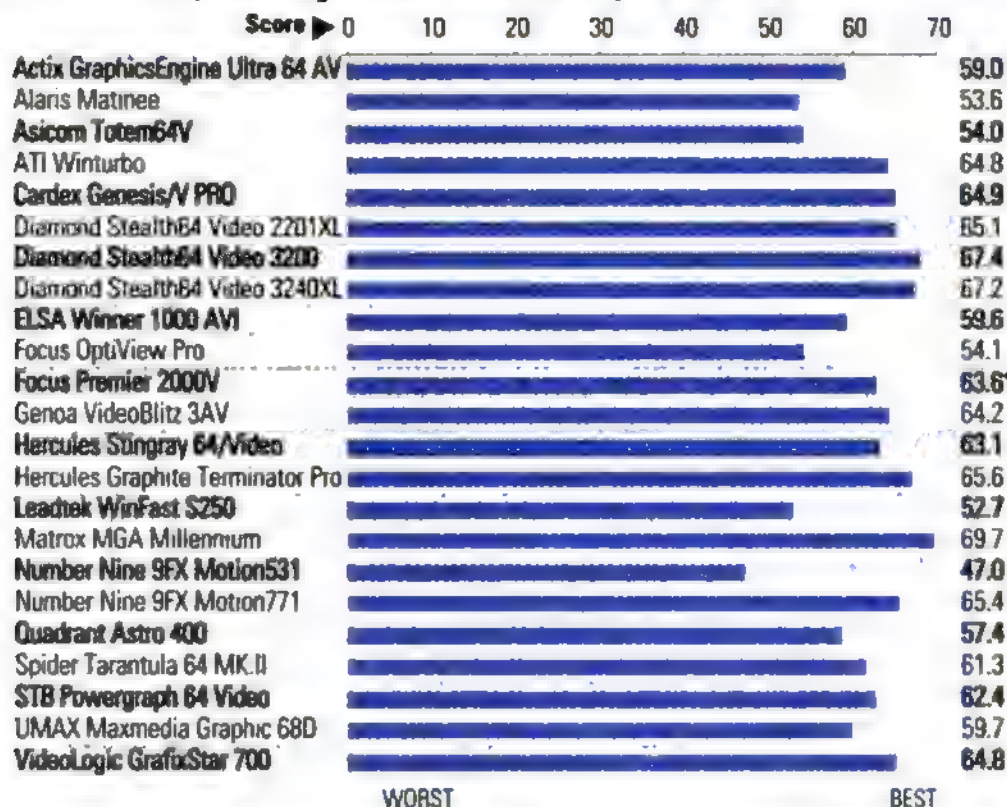


800-by-600 resolution, 24-bit color

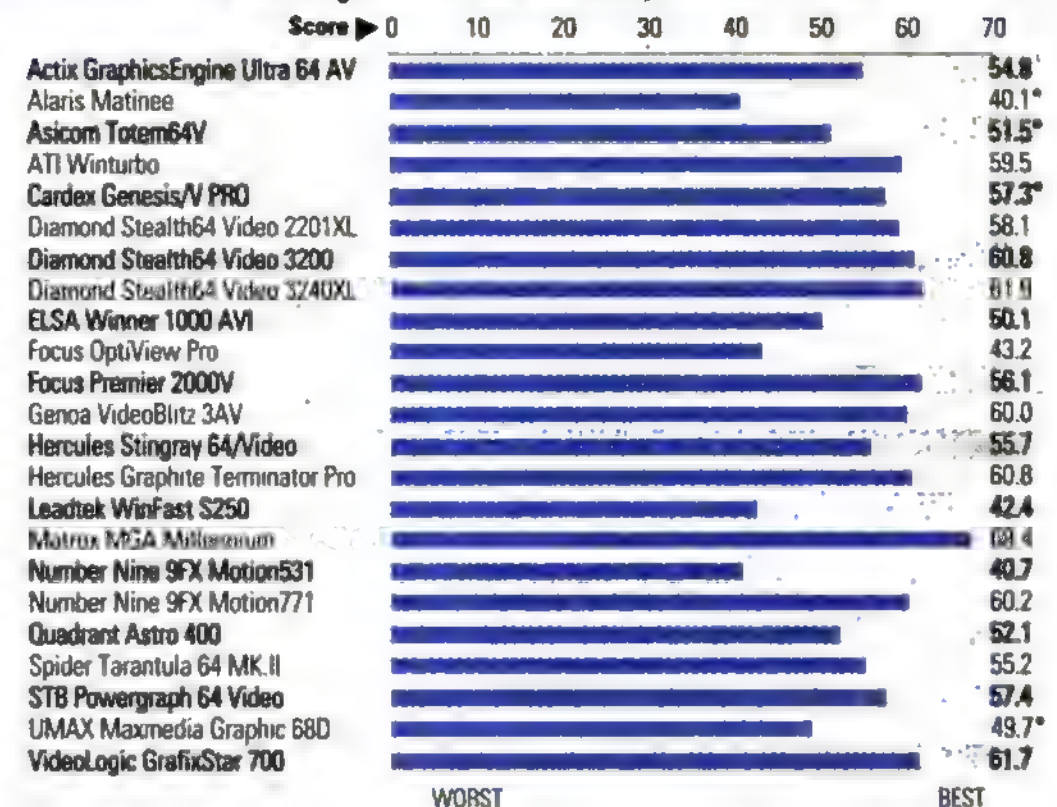


WINSTONE 96

1,024-by-768 resolution, 16-bit color



800-by-600 resolution, 24-bit color



* The card could not achieve this score while maintaining a VESA-compliant refresh rate of 75 Hz

Mainstream Accelerator Boards

CONTINUES

flat out or coming incredibly close. What was even more surprising was their superior performance in mainstream resolution graphics and in video acceleration.

Four new inexpensive chip solutions emerged as star video performers in this evaluation: the Alliance ProMotion 6422, the S3 Trio64V+, the Trident 9680 and the IC Works ZoomDAC coupled with the ARK2000PV controller. These DRAM magicians outperformed most of the powerhouse 64-bit VRAM/WRAM controllers in digital video playback and scaling performance. They were bettered only by the Weitek Power Player 9130 on our subjective scaling tests.

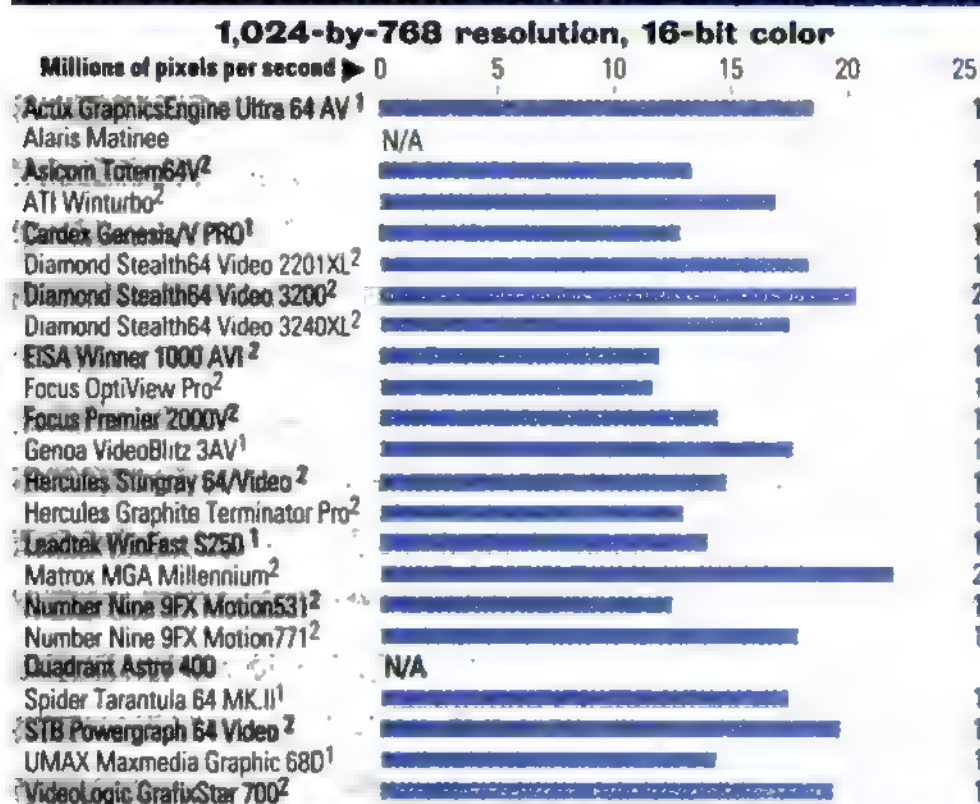
We used two relevant video performance tests from WinBench 96 in two resolutions: 800-by-600 at 24-bit color and 1,024-by-768 at 16-bit color, both running under Windows 3.1. While most boards provided adequate nonscaled video playback performance at 1024-by-768 at 16-bit color, our scaling quality tests (conducted by a jury) showed that the newer chips delivered smoother and less pixelated results.

The jury selected one clear winner: the Weitek Power Player 9130.

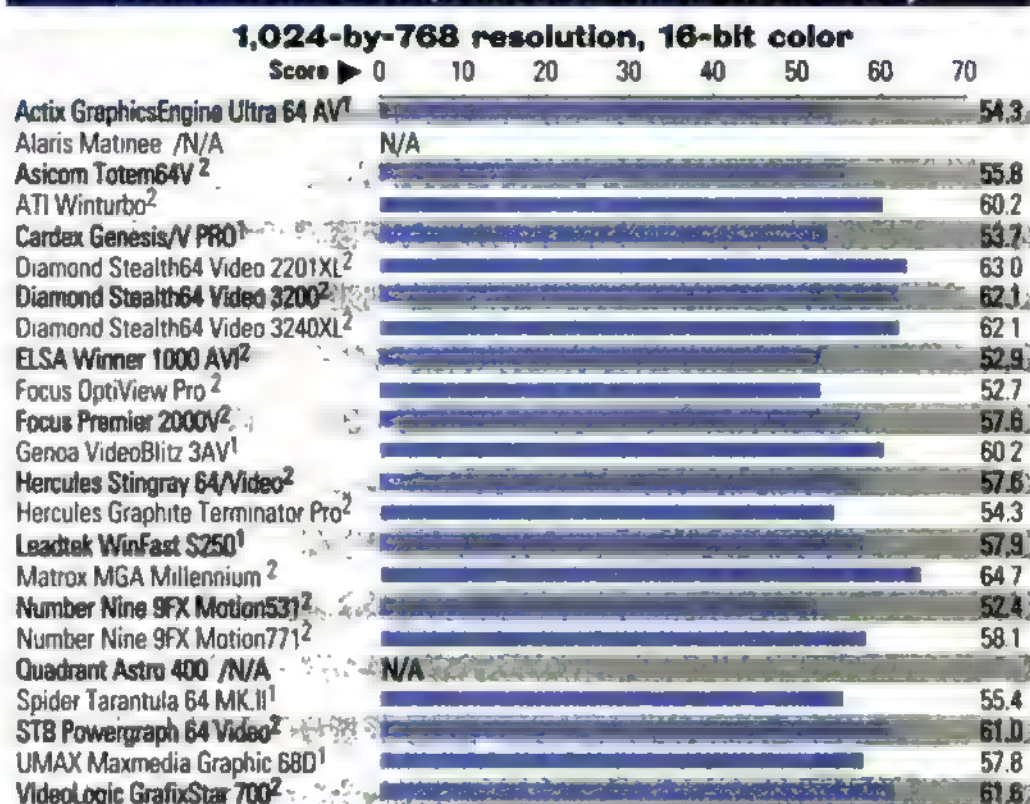
Second place: Alliance ProMotion and S3 Trio64V+.

Third place: Trident 9680.

GRAPHICS WINMARK 96 (UNDER WINDOWS 95)

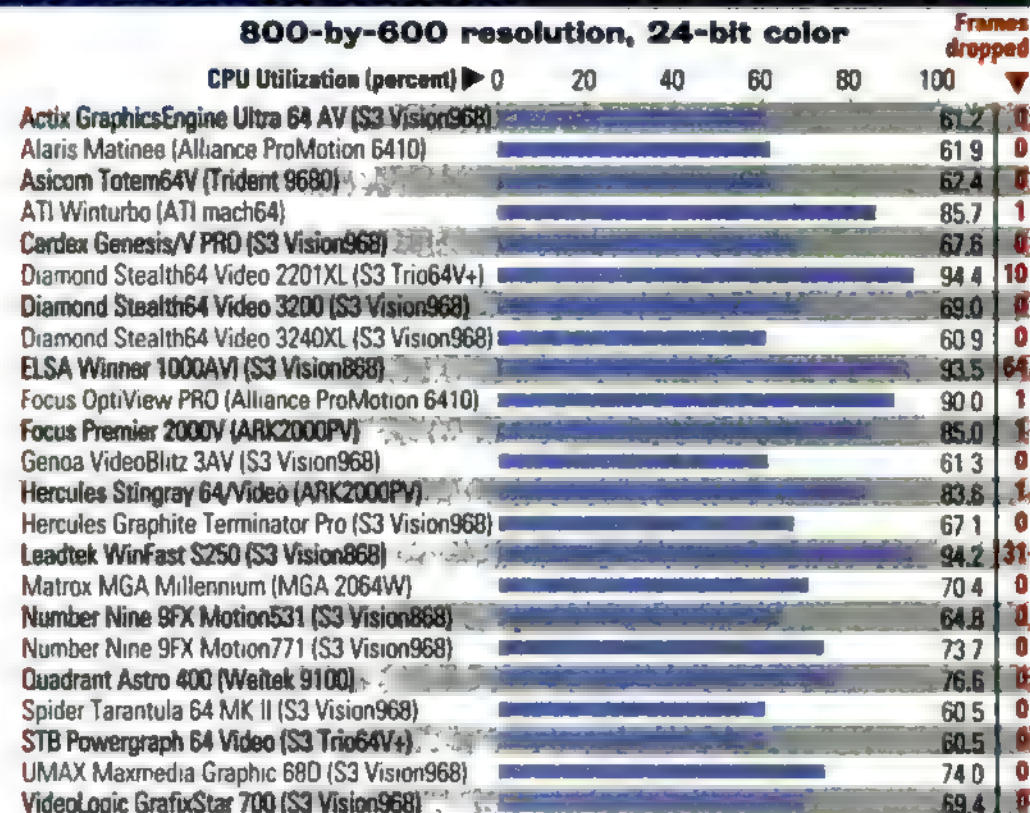
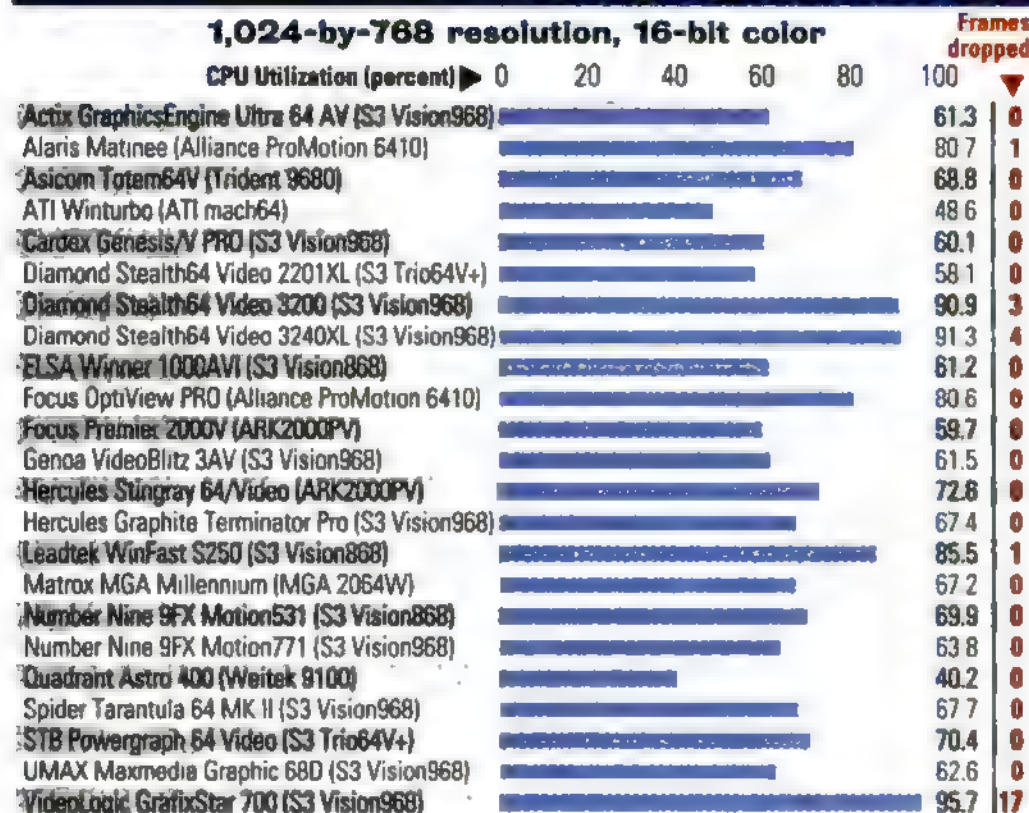


WINSTONE 96 (UNDER WINDOWS 95)



N/A—Not applicable: The product could not complete this test. 1 With generic Windows 95 drivers. 2 With vendor-supplied drivers.

VIDEO/ACTION 320-BY-240 PLAYBACK WINDOW



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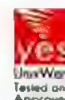
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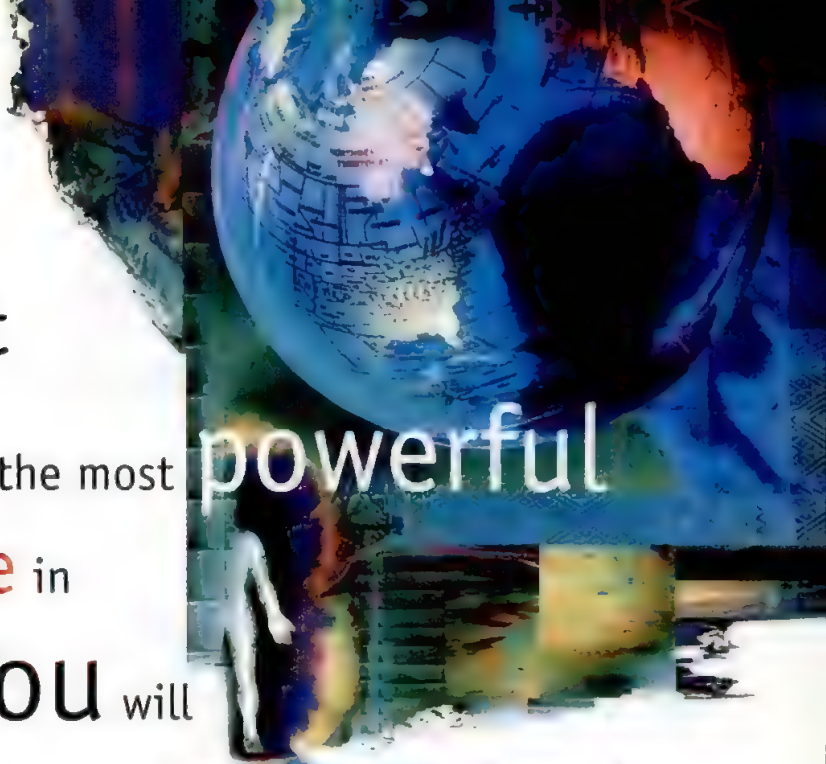
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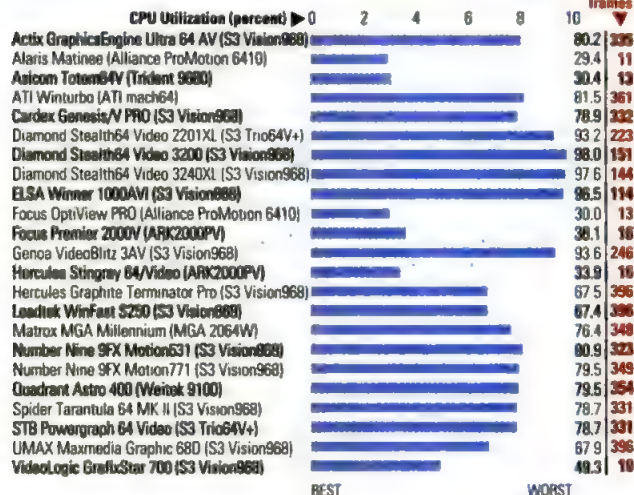
Benchmark Tests: Mainstream Graphics Accelerators

CONTINUES

VIDEO/ACTION FULL-SCREEN PLAYBACK

800-by-600 resolution, 24-bit color

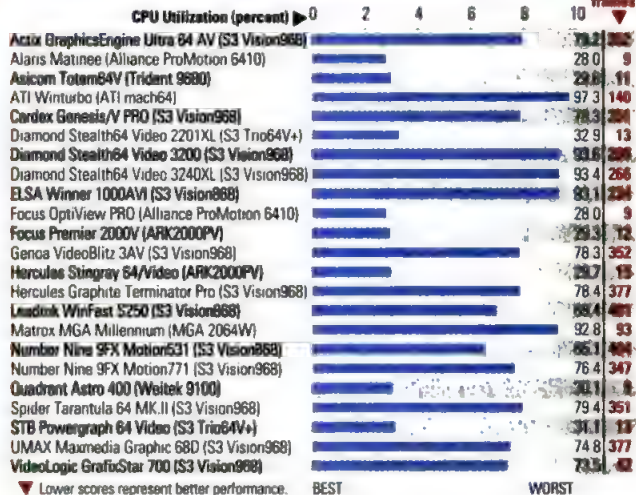
Dropped frames



BEST WORST

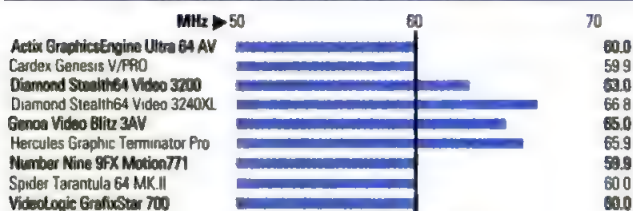
1,024-by-768 resolution, 16-bit color

Dropped frames



Lower scores represent better performance. BEST WORST

MEMORY CLOCK SPEED



Chips that run faster than the rated speed may burn out prematurely without offering significant performance gains.

RATED SPEED

Fourth place: ATI mach64, IC Works ZoomDAC, and Matrox MGA Millennium.

Fifth place: S3 Vision868 and Vision 968.

The Video Action test, which runs an Indeo 3.2, 320-by-240, 30-frame-per-second (fps), 300-kilobyte-per-second (Kbps) data rate, shows that both frames dropped and the CPU utilization results on playback of an average action video clip. The Scale to Full Screen test, which uses a 120-by-160, 30-fps, 300-Kbps data rate and scales the playback to full screen, also reports that frames dropped and the CPU utilization results.

On the Video Action test at both resolutions on Windows 3.1, most products didn't drop any frames. We discounted results of fewer than 10 frames dropped. The CPU utilization numbers were lower for chip sets that treated the video stream differently, using an overlay window for video playback. By sending the video frames to the screen in overlay mode, the video can coexist independently of the GDI-based screen image in off-screen memory in its native YUV format.

Though the implementations differ, the ProMotion,

Trio64V+, and Trident chips postprocess the video stream on its way out to the monitor. Also, performing tasks such as color space conversion as the video is on its way out to the screen saves CPU cycles.

Full-screen scaling tests show a dramatic difference between the boards that push raw pixels and chip sets that use the video overlay mode regardless of color depth. The scale process takes place as the video stream is moved out of the off-screen frame buffer and is color-space-converted to analog RGB mode.

Notably, even at the 16-bit color depth, the video is actually being played back in true-color mode, since it's sent out to an overlay window.

The ZoomDAC approach is similar but slightly different. The ARK2000PV chip, which it is coupled with, doesn't scale the video data, even though a software call to scale has been made. The ZoomDAC detects the call to scale, and it processes on the fly as it's doing the digital-to-analog conversion to the screen. This happens without imposing any stress on the graphics controller sitting at the front end.

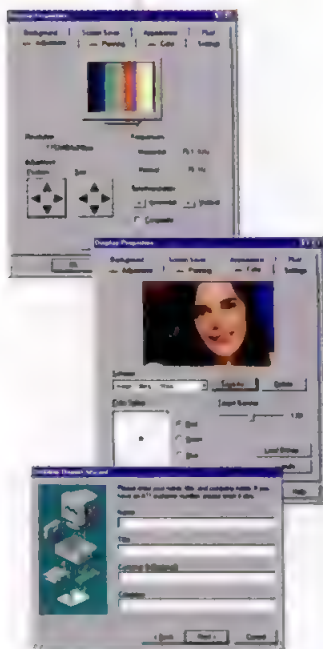
The older Weitek combination of the Weitek 9100 graphics controller and the PowerPlay video accelerator and scaler were present on the Quadrant Components Astro 400. This chip set also has low CPU utilization scores, indicating that the separate video processor is doing a good job of offloading the video stream from the CPU. The Astro 400 may not be the best representative of the Weitek's graphics performance, though. We examined the memory clock speed of the Astro 400 and found it to be running at 45 MHz, 5 MHz below the specification, indicating that the

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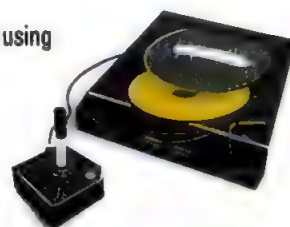
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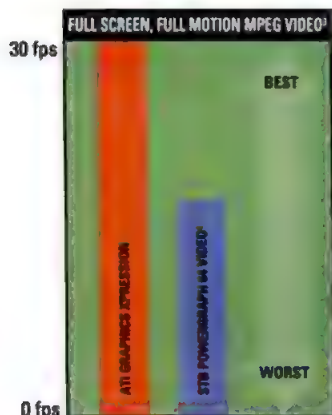


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CIRCLE 127 ON READER SERVICE CARD





Benchmark Tests: Mainstream Graphics Accelerators

ENDS

board may have been using substandard VRAM.

For raw GDI graphics acceleration, many board manufacturers achieve higher pixel throughput by pushing the memory clock on the controller chip beyond the vendor's specification (pushing the RAMDAC's dot clock can have a performance impact, too). Running electronic products beyond specification can introduce the possibility of parts burning out before their time. We present memory clock frequency test results on boards using the S3 Vision968 chip. We chose to chart this chip solely because it's the one most widely used in the products we evaluated. When looking at the Memory Clock Speed chart and checking it against benchmark results, we suggest you weigh the results against the length of warranty given by the board's manufacturer.

In addition to being potentially harmful, boosting the memory clock alone may not even give a board a performance edge. Our Winstone 96 and Graphics Winmark 96 charts show each product's performance at our test resolutions of 800-by-600 at 24-bit color and 1,024-by-768 at 16-bit color. The results indicate that the best performance is usually achieved by the combined strengths of a strong controller and optimized drivers.

For example, the Hercules Graphics Terminator Professional couldn't attain performance equal to that of the Diamond Stealth64 Video 3240XL under WinBench at 1,024-by-768 at 16-bit-color mode, even though both products on the Vision968 exceeded close to 10 percent above the specification. A closer investigation of the more than 200 individual tests that make up WinBench clearly showed differences in levels of driver optimization.

On the memory-to-screen BitBlt test (not represented here), the Hercules Graphite Terminator Professional turned in a 14.5-megapixel-per-second result compared with the Diamond Stealth64 Video 3240XL's 30 megapixels per second. And on the color bitmap-to-screen test, the results were 11.7 and 22.7 megapixels per second, respectively. On the same test, the Number Nine Motion771 got a 20.8 megapixels per second and the Genoa VideoBlitz 3AV scored a 15 megapixels per second. The Number Nine board, which didn't push the clock at all, derives its advantage solely from driver optimization, since all these boards use the same controller chip.

Under Winstone at 1,024-by-768 at 8-bit color, results were quite close across the board, with no more than a 14 percent difference from the fastest to slowest performer. The same was true on WinBench at this resolution, where the spread was 18 percent. These results indicate that the graphics bottleneck present at this color depth is diminishing, and since bandwidth limitations weren't as heavily imposed on the hardware, there are DRAM boards interspersed with VRAM

boards. This changes at higher color depths; you can see it in our 800-by-600 at 24-bit benchmark test charts. In most areas of graphics performance, the more expensive VRAM boards outperform the DRAM boards, and the Winmark score spread from product to product jumps up to 70 percent.

The Windows 95 benchmark charts show Winstone and WinBench results in 1024-by-768 at 16-bit-color mode. We provide these results only for your interest. We haven't drawn any conclusions, nor do we make any comparisons between these results and performance results under Windows 3.x. At the time of our testing, we saw scores dramatically change with each revision of the Windows 95 drivers, and we expect that to continue until each vendor comes closer to releasing a fully functioning driver.

How We Tested

PC Labs used 133-MHz PCI-based Micron Millennia Pentium systems for all tests. The Millennia used Phoenix's plug-and-play BIOS v4.04, had 256K of external cache, and it was equipped with a BusLogic BT-946C fast SCSI PCI host adapter, a Conner CFP210S 2GB SCSI hard disk, a Plextor 6 Plex PX-63CS internal CD-ROM drive, and a Creative Labs Sound Blaster AWE32.

Each test system was configured with MS-DOS 6.22 and Windows for Workgroups 3.11 with a 4MB Vcache setting and a 48MB permanent swap file. We used the 17-inch MAG InnoVision MXP17F color monitors. To perform Windows 95 tests, we upgraded the existing Windows-based machines with the released version of the Microsoft Windows 95 Upgrade package.

For mainstream application, usability, and driver stability testing, we installed CorelDraw 5.0, Microsoft Excel 5.0, Microsoft Word for Windows 6.0, Paradox for Windows 5.0, Visio 4.0, and 2 DOS-based applications: Qmodem 5.0 and Tetris.

To test the boards, we used the prerelease versions of PC Labs WinBench 96 and Winstone 96 (see Lab Notes in this issue for a complete discussion of our new benchmark tests).

We ran each graphics accelerator board through a multipart testing script, designed for this story, which is composed of many categories of tests. As part of our installation tests, we examined the overall design and production quality of each board and rejected any products that were engineering samples or prototypes, didn't meet our price filter, or didn't comply with the 75-Hz VESA vertical refresh standard. Additionally, we evaluated driver installation and setup and logged and evaluated all driver firmware, add-ons, and utilities. We tested the board for VESA-compliant screen refresh rates and monitor setup using the Extron SRI 200, a hand-held device that reads the refresh rate directly off the screen.

Among the tests not represented in our charts are our mainstream usability and driver stability tests, which include loading a series of Windows applications and DOS applications running in a DOS window. This stress test evaluated color-palette handling across color depths, in addition to speed degradation under limited Windows resources. The results of these tests are represented as part of an overall rating in our price/performance index.

—Analysis by Jeff Mace

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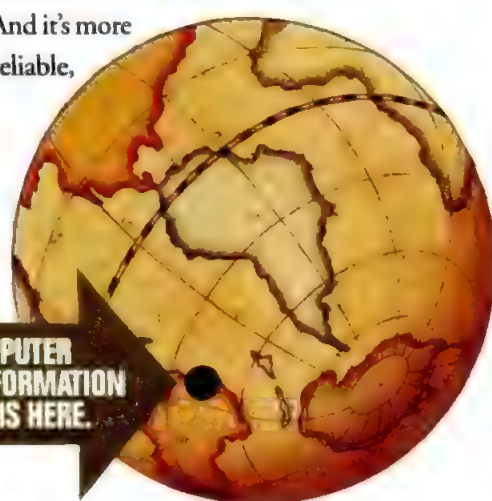
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Mainstream Accelerator Boards

the 2MB version with standard VRAM memory chips.

With 2MB of VRAM, the card can reach a maximum resolution of 1,600-by-1,200 pixels, albeit with only 256 colors and a less-than-optimal vertical refresh rate of 60 Hz. But the Tarantula 64 MK.II easily achieves ergonomic refresh rates in lower resolutions, with a 75-Hz rate available in 1,280-by-1,024 mode with 256 colors, and an 80-Hz rate available in 1,024-by-768 mode with 65,000 colors. True color support is provided in 800-by-600 mode with a maximum vertical refresh rate of 90 Hz.

FEATURES WEB

Like most of the cards in the group we reviewed, the Tarantula 64 MK.II comes with a full complement of basic Microsoft Windows 3.1 utilities. The DOS installation program included its own graphical interface, which make things easier, and happily, there are no jumpers or DIP switches to deal with. Spider's Windows 3.1 utilities are managed via a small toolbar. The controls let you center the on-screen image and change DPMS power-saving settings, as well as switch resolutions, refresh rates, and color depths. Unless you're using the board's virtual screen settings, you'll have to reboot Windows 3.1 when changing resolu-

have all the conveniences expected of leading accelerator cards. For example, it does not have a zoom feature or a vertical-refresh-rate preview, and to select a

*The Tarantula 64
MK.II is an easy-to-
install, jumperless card
with respectable
Windows performances
and a good selection of
software utilities.*

particular monitor setting you have to use a DOS utility.

On the other hand, for Windows 3.1 users, the Tarantula did well on Graphic Winmark tests in 800-by-600 mode with 16.7 million colors. But it was only about average on higher resolution WinMark performance tests and slowed considerably on application tests, achieving below-average WinStone scores.

On video playback tests, the Tarantula 64 dropped only a few frames in the 30-

frame-per-second Cinepak 320-by-240 window size. It had no trouble handling Indeo files and produced better-than-average data rates on our window-scaling tests. Like most of the cards in this price range, however, Spider's board does interpolation only on the axis, so video clips scaled up to full-screen size look blocky and jumpy.

Spider does include the Xing MPEG player on a bundled CD-ROM. On subjective tests, it handled MPEG files smoothly on faster Pen-

tium systems, although the resolution of some images using the software decoder looked slightly grainy.

Running the Tarantula 64 in Windows 95 proved simple enough using Mi-

crosoft's standard S3 driver. At press time, Spider was planning to port all of its Windows 3.1 utilities into the Windows 95 environment, and these should be available by the time you read this.

While lacking some details offered by more expensive cards, overall the Tarantula 64 MK.II is an easy-to-install, jumperless card with respectable Windows performance and a good selection of software utilities.—John R. Quain

Tarantula 64 MK.II. List price: \$275. Spider Graphics Inc., 580 Charcot Ave., San Jose, CA 95131; 408-526-0535; fax, 408-526-1622.

Circle 456 on reader service card

STB Systems Inc.

Powergraph 64 Video

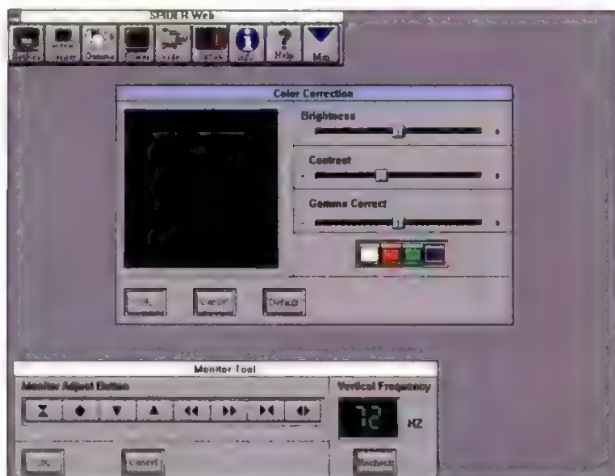
An average performer on our graphics benchmark tests, STB Systems' nicely priced \$229 Powergraph 64 Video card combines above-average video performance and a range of expansion options with a capable set of Microsoft Windows 3.x and Windows 95 utilities. The board is particularly suitable for multimedia enthusiasts.

STB designed the Powergraph 64 around S3's Trio64V+ chip set, which incorporates both graphics and DAC circuitry as well as video acceleration into one chip. The Trio64V+ also has the ability to overlay video windows at a higher resolution than the current graphics mode.

The Powergraph 64 is a compact board configured with 2MB of EDO DRAM, a VESA Feature Connector, and connectors for optional MPEG and TV-tuner daughtercards. The Powergraph 64 ships with drivers for DOS, Windows 3.1, Windows 95, Windows NT, and OS/2, and the board supports AutoCAD and MicroStation. STB is one of the few manufacturers we looked at for this roundup that supplied a Windows 95-based display-control utility and manual at the time of writing. Xing's MPEG playback software and two CD-ROMs—Maximum Overkill and Family Doctor—round out the bundle.

NO SURPRISES

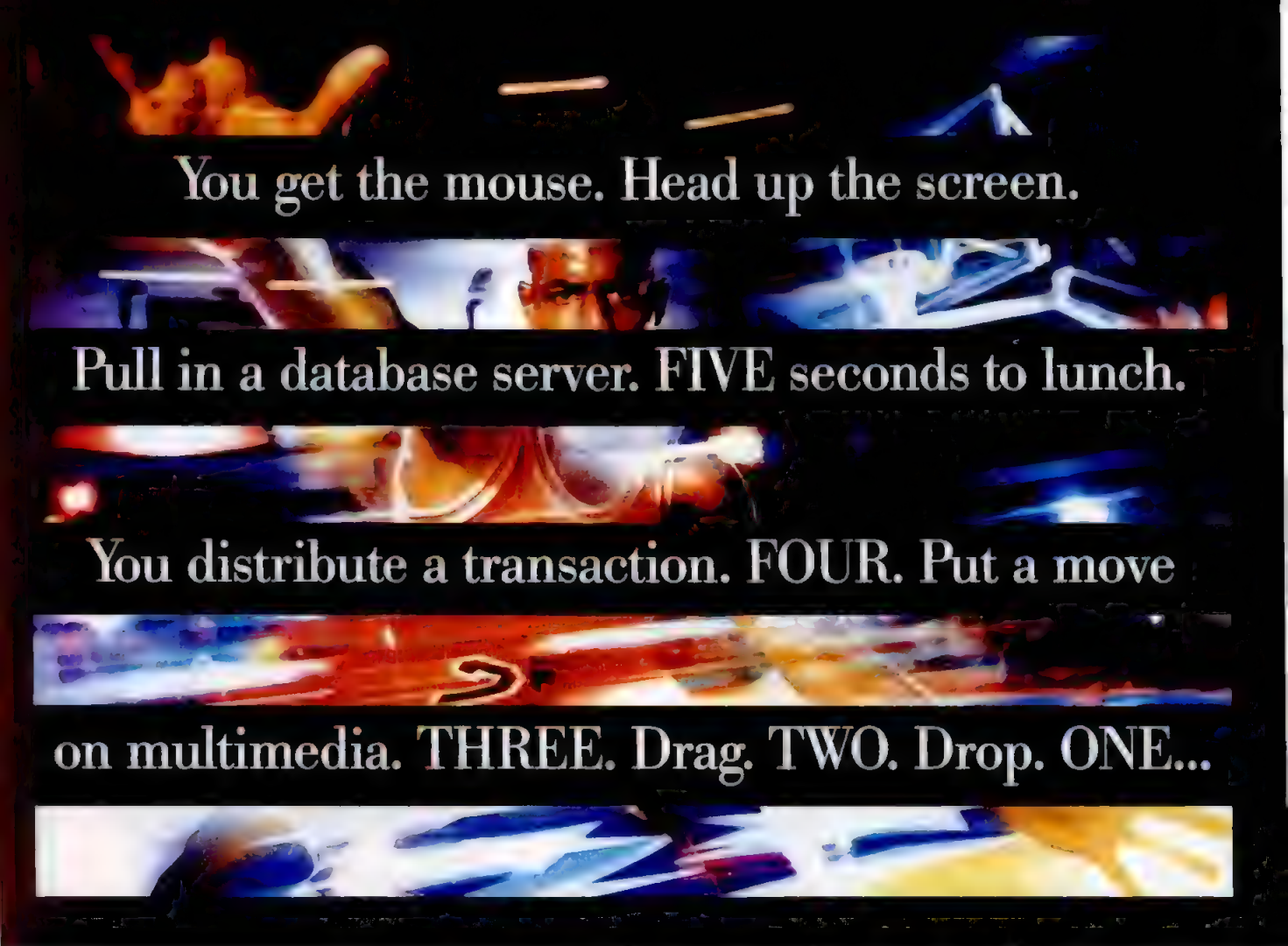
Windows 3.1 installation was straightforward and uneventful, aided by the 333 monitor presets. The configuration soft-



From Windows 3.1 Tarantula 64 MK.II's convenient toolbar, users can change most of the card's settings, including basic color adjustments.

tions. The color-correction utility, while adequate for general business and home use, could be more precise.

By and large, the Tarantula 64's software features are handy, but it doesn't



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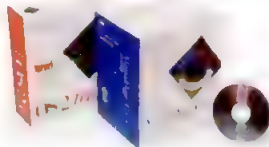
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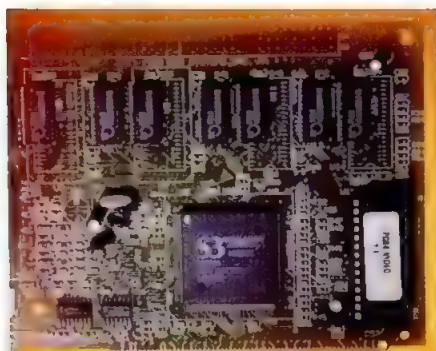


ViewSonic 17



CIRCLE 118 ON READER SERVICE CARD

Mainstream Accelerator Boards



STB's Powergraph 64 Video achieves the small footprint by using the S3 Trio64V+ controller.

ware enables on-the-fly refresh-rate selection with monitor centering and preview functions.

STB's display utilities software provides a virtual desktop with on-the-fly resolution switching. While the software appears to provide for dialog-box centering, these controls apply only to the STB software (unlike other products in this evaluation that offered similar features); the controls do not apply to messages gener-

ated by Windows 3.x or other programs, which is somewhat confusing. Other software features include a comprehensive Zoom and Bird's Eye utility and a Multiple Desktop manager, which lets users customize and associate graphics configurations with different applications.

The Windows 95 display utilities also installed smoothly, resembling the Windows 3.1 software in appearance and functionality, a nice feature for those users who are supporting both environments. Unlike Windows 95's generic configuration controls, STB's custom application enables advanced features such as virtual desktop and refresh-rate control. This somewhat makes up for the small quirks we found in the Windows 95 control, like not graying out unavailable resolution and color-depth options, which hampered configuration adjustment. An improved version of the driver should be available by the time you read this.

PERFORMANCE TESTING

The Powergraph 64 generally performed in the midrange on most WinBench and

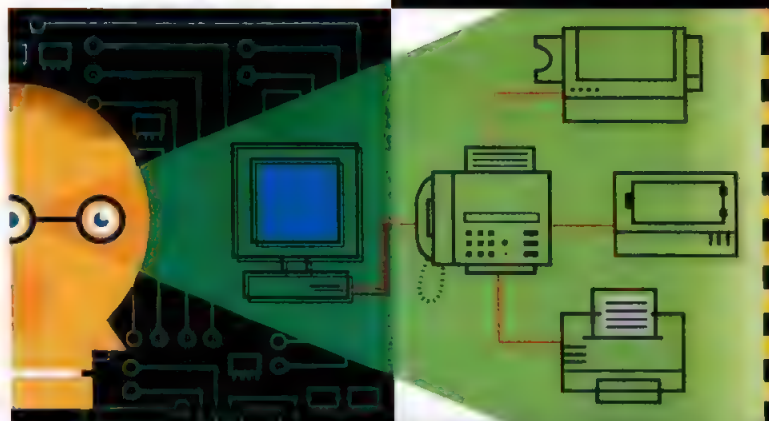
WinStone testing, though somewhat behind the other Trio64V+ board in the roundup. The Powergraph 64 fell down somewhat on driver-stability tests, failing to load all test applications.

On the multimedia front, STB Systems' Powergraph 64 performed extremely well on Video for Windows playback and efficiency tests. Playback on unscaled video was excellent. Furthermore, at higher color depths and quarter-screen playback, the Powergraph 64 produced average performance. Like all S3-based products, video that was zoomed to higher resolutions was somewhat pixelated. Even so, this performance, combined with hardware MPEG and TV-tuning options, makes the Powergraph 64 an attractive choice for multimedia aficionados.—Jan Ozer

Powergraph 64 Video. List price: \$229. STB Systems Inc., 1651 North Glenville Rd., Richardson, TX 75081; 214-234-8750; fax, 214-234-1206.

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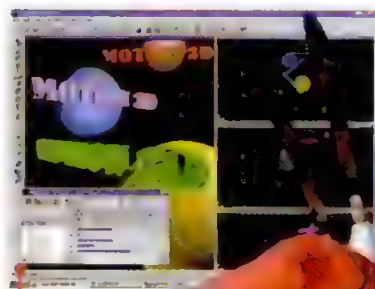


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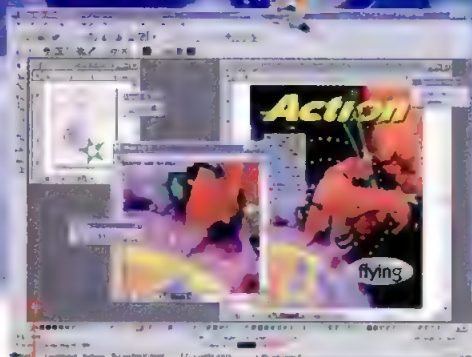
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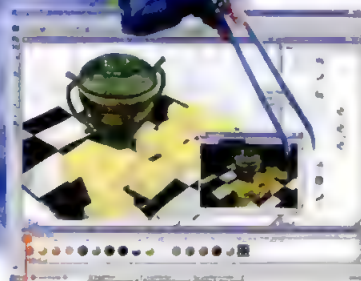
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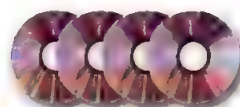


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Mainstream Accelerator Boards

UMAX Technologies Inc.

Maxmedia Graphic 68D

UMAX Technologies' \$199 Maxmedia Graphic 68D offers mid- to above-average hardware performance hampered by quirky, substandard Microsoft Windows 3.1 software utilities and minimum Windows 95 functionality. The Maxmedia Graphic 68D is well suited for the cost-conscious Windows 3.1 user needing flicker-free, high-resolution graphics, but it's a poor choice for those requiring even moderate software functionality.

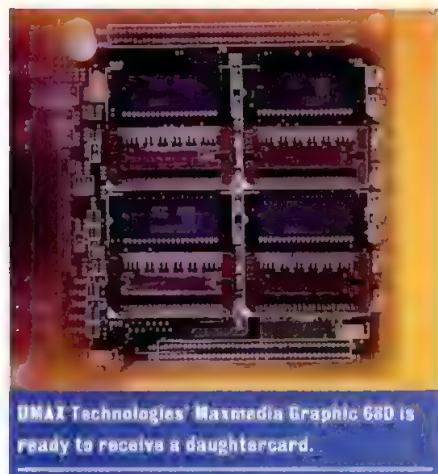
UMAX based the Maxmedia Graphic 68D on S3's Vision868 graphics chip with 2MB of DRAM, expandable to 4MB. The board includes a VESA feature connector but no connectors for

ed during installation didn't match those depicted in the manual; we learned from UMAX technical support that the MPEG playback software referred to in both the manual and the READ.ME file did not ship with the product.

The Windows Video Panel that controlled graphics and monitor configuration was similarly frustrating. Several features, such as audio, video, cursor

control, and color calibration, were present in the S3-supplied interface but grayed out and inaccessible in the UMAX product.

On the positive side, UMAX's refresh-rate control was well-rounded and flexible, providing refresh-rate previewing, monitor centering, and on-the-fly refresh-rate switching. UMAX also supplies a spyglass feature enabling up to 16X



UMAX Technologies' Maxmedia Graphic 68D is ready to receive a daughtercard.

MPEG or other daughtercards. UMAX supplies DOS, Windows 3.1, OS/2, and Windows NT drivers, and compatibility with the generic S3 Vision868 driver included in Windows 95. The Maxmedia Graphic 68D ships with AutoCAD and Microstation drivers but does not include a Video for Windows runtime or MPEG playback software.

S3 REFERENCE DESIGN

The disks and manual shipped with the Maxmedia Graphic 68D are all generically labeled "S3-868 Graphics Card," evidencing UMAX's lack of investment in software functionality. Installing the product's Windows 3.1 drivers was unnecessarily confusing because the installation program lacks the normal prompts found with other programs. For example, the Windows group and program icons creat-

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CIRCLE 306 ON READER SERVICE CARD

Mainstream Accelerator Boards

zooming and a Bird's-Eye View showing placement of the viewport on the virtual screen.

By using the generic S3 Vision868 driver for Windows 95 operation, the driver will figure out a reasonable refresh rate for the monitor.

HARDWARE PERFORMANCE

Compared with other S3 Vision868-configured boards, the Maxmedia Graphic 68D was either average or above average on Winstone and WinBench tests. On refresh-rate testing, the Maxmedia Graphic 68D successfully produced 1,280-by-1,024, 8-bit resolution at a comfortable 90 Hz, and 1,024-by-768, 24-bit resolution at a rock-solid 120 Hz, illustrating suitability for wide multicolumn spreadsheets and similar applications.

The Maxmedia Graphic 68D also performed well on video-playback testing, albeit with the same blockiness and pixelation evidenced by other S3 Vision868 products when zooming video to higher resolutions.

The Maxmedia Graphic 68D faired poorly on Windows stability tests, failing to load all test applications and corrupting screen display after repeated testing. This doesn't bode well for those who frequently switch among multiple open applications.

With a focus on hardware performance rather than software features and stability, the Maxmedia Graphic 68D is probably better suited for VARs and system integrators developing dedicated applications than for corporate or SOHO end users.—*Jan Ozer*

Maxmedia Graphic 68D. List price: \$199. UMAX Technologies Inc., 3353 Gateway Blvd. Fremont, CA 94538; 800-562-0311, 510-651-9488; fax, 510-651-8834.

Circle 458 on reader service card

VideoLogic Inc.

GrafixStar 700

VideoLogic's GrafixStar 700, \$249 (with 2MB VRAM), is an S3 Vision968-based graphics accelerator board worth consideration for factors beyond raw performance. Priced right and easy to work with, the GrafixStar 700 is a reasonable choice, as long as you're not expecting stellar graphics or

digital video playback.

The board attained average to below-average performance scores (especially when comparing digital video results), but its documentation is excellent and a



VESA Media Channel connector lets you add a variety of options for multimedia applications.

VideoLogic uses an IBM 64-bit RAM-DAC in conjunction with the S3 Vision968 processor. If you want a 4MB version of the GrafixStar 700, be prepared to pay \$449. Why \$200 more?

The only way to add memory is to buy an entire VMC (VESA Media Channel) daughtercard. You can buy the VMC without memory (for \$49), but you can't buy the memory upgrade separately. The optional modules, which you plug into the VMC (regardless of whether or not it has the 2MB upgrade), include the VideoLogic Captivator Pro (\$179), which allows you to play video input; the Captivator ProTV (\$229), which adds a TV tuner; and the VideoLogic MPEG Player (\$249).

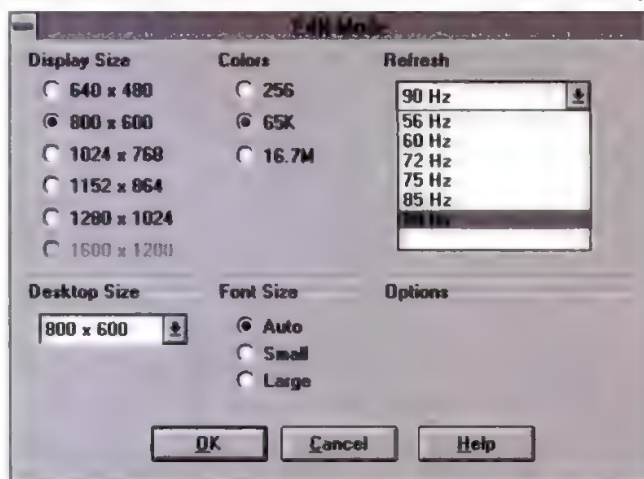
DRIVER FACTS

The board's Microsoft Windows 3.1 drivers and utility software install directly from Windows, facilitated by comprehensive and well-illustrated docu-

mentation. Windows 95 drivers were also included. The board's driver wouldn't work, however, until we replaced the original BusLogic SCSI adapter with an Adaptec SCSI controller. The GrafixStar 700 also comes with Video for Windows 1.1e and Xing MPEG playback software.

Setup is simplified by easy-to-follow software. There are 323 monitors in the program's pick list, including custom settings to try if you can't find your monitor. After the board and software were installed, it was easy to change video settings using VideoLogic's SmartTools utility, which lets you switch between supported resolutions, center dialog boxes, and pan and lock the virtual display.

The board ran at 75 Hz in both 800-by-600 and 1,024-by-768 resolutions, meeting the current VESA specification. There's no refresh-rate test or preview in Windows 3.1. Under Windows 3.1, you can switch resolutions on the fly using the virtual desktop, but you'll have to restart Windows if you change resolutions without the virtual desktop



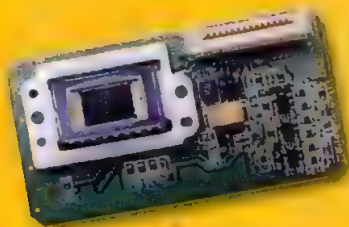
VideoLogic's GrafixStar 700 lists over 300 monitors with video setting presets for each. Within in each setting you can specify desktop size, display size, color, refresh rate, and font size.

turned on, or if you want to change color depth.

TWINKLE, LITTLE STAR

The GrafixStar 700 was a competent but not outstanding performer on Graphics WinMark testing, with midrange scores compared with other VRAM-equipped boards, in all resolutions and color

This is the film.



Okay, so it isn't film. It is, however, the highly photosensitive CCD sensor that captures images in a *Kodak Digital Science™* DC40 camera.

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Storage memory:	4 MB RAM	Batteries:	4 AA lithium
Compatibility:	PC and MACINTOSH computers	Depth:	6.1 inches
Capacity:	48 high-resolution 99 snapshot-resolution	Width:	5.3 inches
		Height:	2.2 inches
		Weight:	1 pound

The reasons for the DC40's clarity are many. The built-in, full-frame CCD sensor, and Kodak's patented color filter array pattern allow the DC40 to read and capture images with amazing precision.

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depths. The Winstone 96 scores were also about average for this card type. Winstone testing resulted in midrange scores in 800-by-600 at 24-bit, 1,024-by-768 at 8-bit, and 1024-by-768 at 16-bit modes.

This board's performance in scaled video playback was significantly better than the other 968-based boards. It also dropped only 42 frames on our 1,024-by-768 at 16-bit scaling test—where most 968-based boards dropped more than 200 frames. And when the board played back scaled video, its color fidelity was particularly impressive.

When we scaled our sample digital-video test files, the GraftixStar 700 did manage full-screen video with far less posterization than the other S3 Vision968-based boards represented here. That result appeared to be mainly attributable to a customized DCI provider. When we used the bundled Xing MPEG player software, we saw some hitching and jumps in the playback, but the im-

*The GraftixStar 700's
setup is simplified by
easy-to-follow software.
There are 323 monitors
in the program's
pick list, including
custom settings.*

ages were noticeably smoother than they were with the Genoa VideoBlitz 3AV, for example.

Backed by a five-year warranty and toll-call technical support weekdays, the VideoLogic GraftixStar 700 may serve you well if you need a strong and consistent graphics performer with a clear upgrade path.

—Bruce Brown

GraftixStar 700. List price: \$249. Requirements: 32-bit PCI or VESA local bus slot. VideoLogic Inc., 1001 Bayhill Dr., Suite 310, San Bruno, CA 94066; 800-245-8587, 415-875-0606; fax, 415-875-4167.

Circle 459 on reader service card

See You Soon: Technologies for '96 and Beyond

Chip designers and graphics accelerator board vendors have big plans for the holidays and spring 1996.

By
Jon Hill

Though some think Windows 95 signals a shift in the graphics acceleration market, the real sea change will occur when a host of new media acceleration technologies hit the market in the coming months. Most of them promise enhanced support for graphics operations as well as added video processing; but a number also add sound and exciting 3-D acceleration and playback techniques.

Current PCs are remarkably inefficient at implementing multimedia: Coordination between ISA-based sound cards and the PCI-based graphics display is nearly impossible, and the slow ISA bus puts an interrupt-driven drain on your CPU. Storing decompressed video in RGB mode sends a huge amount of data over the path between the frame buffer (graphics memory) and the graphics/video controller chip, and it reduces the amount of memory available for other operations. When the video finally shows up on your screen, it's probably slightly out of sync with the sound coming from your speakers, and if your graphics card is running in 256-color (8-bit) mode, the video display will look awful.

The only way to get more realistic-looking video under these front-end video-processing conditions is to run the graphics card in 16- or 24-bit colors, but that puts an even bigger burden on the pathway from the controller chip to the frame buffer.

Ultra high-end graphics cards, like Number Nine Technology Corp.'s Imagine

series, get around some of these problems by brute force. Configurable with up to 8MB of VRAM, the 128-bit-wide pathway between the Imagine chip and its frame buffer has no problem dealing with large amounts of graphics data, and it has plenty of memory to spare for storing video (or 3-D) information off-screen.

S3's new Trio64V+ chip, the engine that drives STB System's Powergraph 64 Video and Diamond Multimedia Systems' Diamond Stealth64 Video 2201XL cards in this review, chops through the video bottleneck by redefining the way



Brooktree's new multimedia-ready MediaStream chip set is coming to a graphics board near you.

Mainstream Accelerator Boards



Number Nine's 9FX Media 574 uses an external hookup device in order to keep the plug-in board size relatively compact.

the graphics card handles nonstandard graphics data. The Trio64V+, the first of a series of revamped S3 chips that are based on the company's Streams Processor and Scenic Highway architectures, can handle up to three separate display streams.

The key to the Streams Processor is its location between the display memory (frame buffer) and the RAMDAC. This position gives the Trio64V+ the ability to perform back-end video processing: The frame buffer can contain 8-bit graphics data in RGB format and unscaled 24-bit video data in its compact YUV form. The video stream is scaled and color-space-converted on the fly by the Streams Processor after it has left an off-screen area of the frame buffer, thus removing a large portion of the bottleneck between the graphics controller and the display memory. The ability to mix graphics modes reduces the overall system demands even further.

MEDIA MOVES IN

Now we're ready to add MPEG decoding to the mix. MPEG files contain both audio and video information. Previously, when you attempted to play an MPEG file through an ISA-based MPEG decoder, the audio data had to travel from the ISA-based MPEG card to your ISA-based sound card, and the video data had to travel from the ISA card through an ISA-PCI bridge to the graphics card (or directly to the graphics card through its 8-bit feature connector—another nightmare).

S3's Scenic/MX1 and Scenic/MX2 MPEG-1 decoders feed YUV data directly into the frame buffer, after which the Streams Processor can take over. The MX2 can be integrated onto a graphics

card, but the MX1 uses the bus-mastering and burst-mode capabilities of the PCI bus. Thus, either chip can send decompressed MPEG video directly to the frame buffer with minimal CPU intervention. Audio information still presents a problem under this approach, but with a suitable audio codec, exchanges across the ISA bus can be minimized.

S3's Trio64V+ provides a good example of back-end processing, but Brooktree's new BtV MediaStream chip set, soon to hit the streets in Number Nine Visual Technology's Media574 board, takes back-end processing a few steps further along its logical path. The BtV MediaStream family, a four-chip set made up of a MediaStream Controller, a PACDAC (packet DAC), an AudioStream Interface, and a VideoStream decoder, stores

*By the end of next year,
integrated multimedia
accelerators will send
traditional 2-D
graphics cards into the
dustbin of history.*

graphics, video, and audio information in the board's common memory location.

The BtV MediaBuffer, which is essentially a superset of the old graphics frame buffer, can keep track of the various data types because it uses a packet-style interface: Each data type is placed into a discrete information packet along with a descriptor that lets the MediaBuffer determine whether to send the data to the board's PACDAC or audio decoder. The PACDAC can use the descriptor to decide whether it needs to scale and perform color space conversions on YUV video data or simply convert standard RGB information into the analog format that your monitor needs. The efficiencies gained through this technique produce some striking benefits: boards like Number Nine's Media574 use standard VRAM to display effortlessly two beautifully interpolated, scaled, true-color video windows at the same time, while indepen-

dently accelerating 8-bit graphics data and sending top-quality wavetable-synthesized digital audio directly to a DAT- or compact disk recorder.

The Media574 will ship in 1MB (\$389) and 2MB (\$479) versions that make it slightly more expensive than any of the boards in this review, but consider that the board combines the functionality of a standard graphics card, a back-end video playback engine, a video capture card, and an audio card.

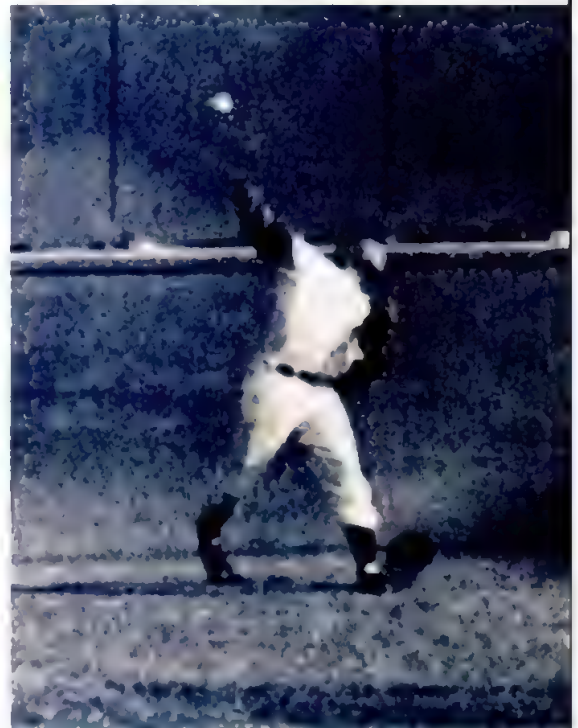
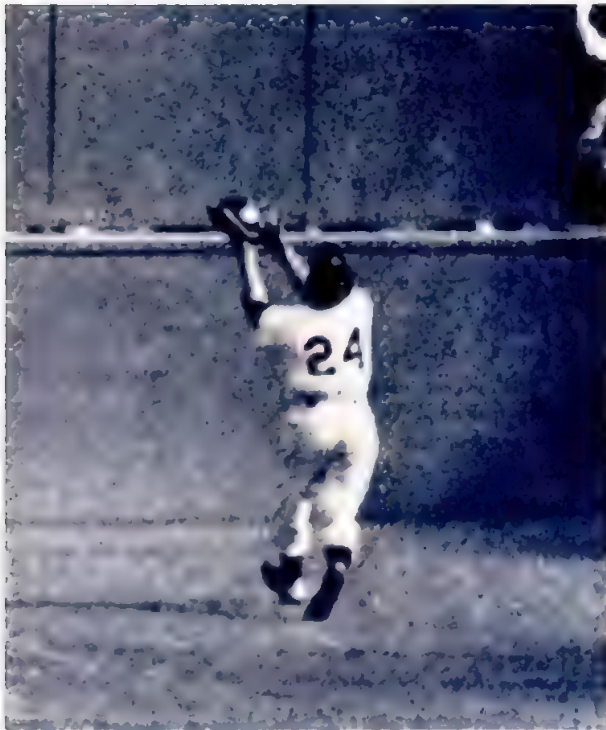
MORE TECHNOLOGY

Nvidia Corp.'s NV1 multimedia accelerator lies at the core of another packet-based architecture. The two-year-old company is funded by a host of venture partners that includes some of the biggest names in the computer industry, and the introduction of the NV1 chip has been greeted by an unprecedented wave of anticipation. The NV1, soon to hit the streets powering the all-new Diamond Edge 3D Multimedia Accelerator (\$249 expected list price), is the first chip to combine 2-D and 3-D graphics acceleration with full-motion video support and integrated wavetable-synthesis audio support. Like the BtV MediaStream chip set, the NV1 provides support for digital game ports, which further relieves the CPU from the stress of constant, interrupt-driven intervention in real-time multimedia activity. Diamond's Edge board does not match Media574's digital audio output, but more than any other product, the nv1 promises to push the lowly PC into the forefront of the lucrative multimedia gaming market.

The NV1 (and its DRAM-based sister



Number Nine's 9FX Media574 can display a free-floating chroma-keyed video overlaid on a graphics window.



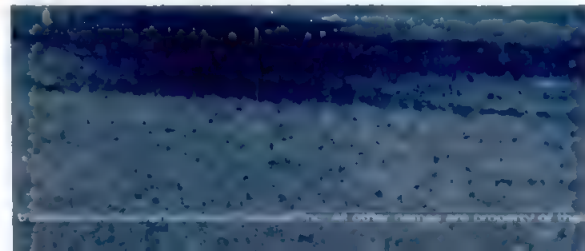
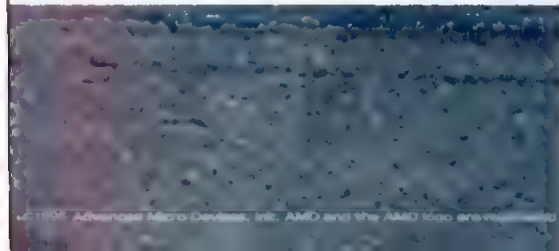


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Mainstream Accelerator Boards

chip, to be marketed by strategic partner SGS-Thomson) does this by breaking an old 3-D paradigm. Most 3-D accelerators create the illusion of 3-D by creating a wire frame of connected polygons (usually triangles) and overlaying a texture map on the bare frame. For any given object, as the number of triangles increases, the illusion of 3-D becomes more compelling. But realistic images force the 3-D accelerator to draw an incredible number of triangles: Most objects contain curved surfaces, but triangles normally have straight edges.

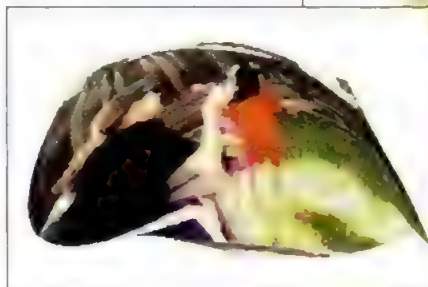
The NV1 breaks this mold by forming polygons with curved edges, thus defining a new set of proprietary GDPs (graphics draw primitives). This method lets the chip create realistic 3-D effects with vastly fewer polygons, resulting in 3-D performance that rivals that of high-end RISC-based graphics workstations. Nvidia wraps this performance edge into a packet-based architecture that allows a stunning level of interaction among graphics, video, and overlays such as texture maps or surface effects (lighting, transparency, and so on) while treating audio as just another multimedia data type.

CHIPS, CHIPS, AND MORE CHIPS

Cirrus Logic's CL-GD5462 VisualMedia accelerator represents yet another approach to the inadequacies of traditional multimedia PCs. The CL-GD5462 is the first member of a family of chips designed to interface with Rambus's revolutionary RDRAM. In a sense, RDRAM provides the same sort of brute force capability that Number Nine Technology Corp. gets from its 128-bit-wide memory path, but Rambus's memory architecture achieves its high-bandwidth goal on a single 9-bit-wide data bus. Nearly every aspect of traditional memory architecture has been thrown out the window in the Rambus specification, from signaling methods to the use of Rambus Channel Masters and Channel Slaves. Conse-

quently, Cirrus Logic has been forced to redesign the CL-GD5462 from the ground up.

The result is a vanishingly small video/graphics subsystem that can simultaneously scale, interpolate, and display three 30-fps video windows, maintain a high graphics resolution and refresh rate effortlessly, and still have plenty of bandwidth left over to support a wide range of ancillary products, including an MPEG decoder, DSP-based modem, TV tuner, and dedicated video conferencing codec. Boards based on the CL-GD5462 accelerator are a



bit behind the Brooktree, Nvidia, and S3-based products in their development cycle, but the technology promises to provide enough bandwidth to satisfy virtually any demand.

A host of other companies will soon



Diamond's new Diamond Edge features the new Nvidia NV1 chip.

jump into the coming multimedia fray: Oak Technologies' Spitfire OTI-64111, which promises to support up to four simultaneous video windows and should interface nicely with Oak's MPEG decoders and CD-ROM controller chips, is probably furthest along its development path; and by the middle of next year, Brooktree, Oak, and S3 will have added 3-D support to their next current 2-D accelerators.

At the high end, Number Nine has incorporated an incredible list of features into its Imagine128 PowerSeries 2 chip, including a

hardwired replacement for the Windows 95 DIB engine, a high performance 3-D drawing engine, and a unique Display List Command Processor that leverages the company's CAD experience into the general market.



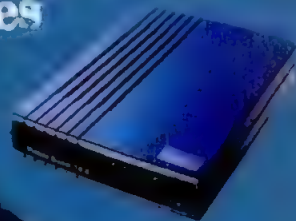
The Nvidia-based Diamond Edge board can use video input as a texture map for 3-D objects. Here, a clip showing a man blowing soap bubbles has been wrapped around a sphere and a more complex 3-D coordinate space.

By the end of next year, integrated multimedia accelerators will send traditional 2-D graphics cards into the dustbin of history, and you'll wonder how you ever managed to get along without them. □

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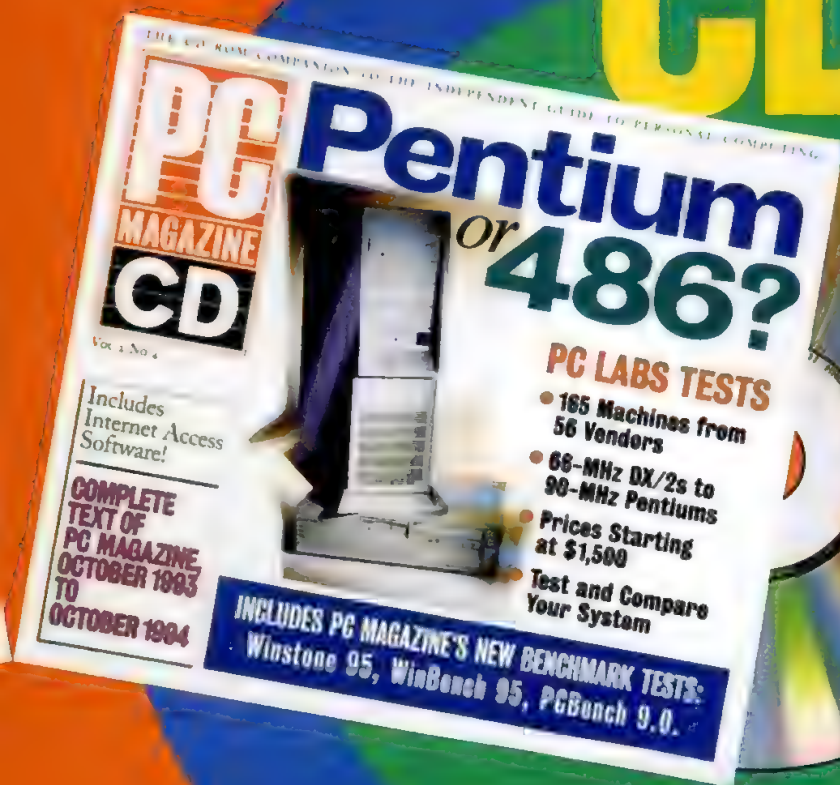
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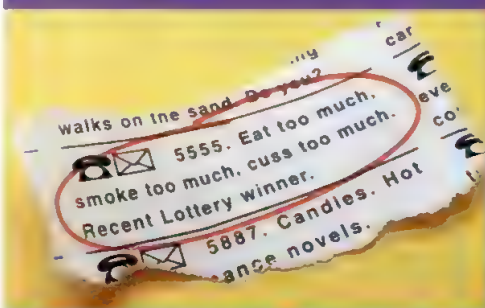
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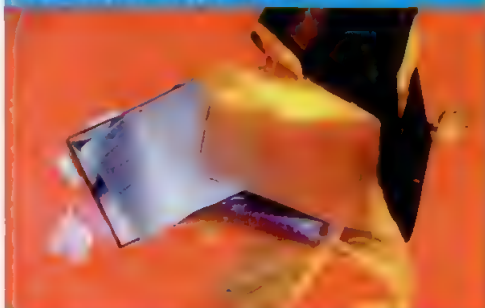
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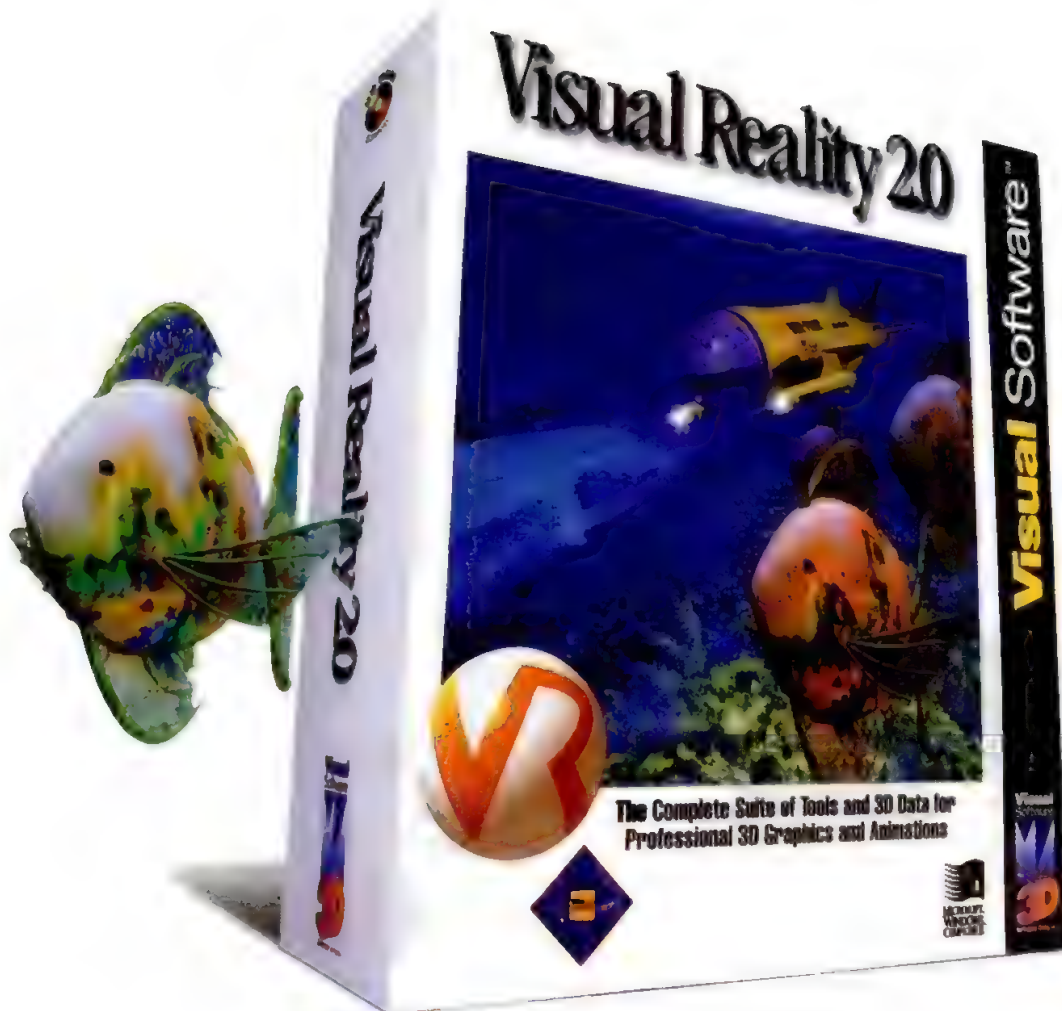
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PC Tech

THE DEFINITIVE GUIDE TO PC TECHNOLOGIES & TOOLS

Windows Code Editors: Programmers' Power Tools

A cutting-edge code editor can still take you further than an IDE.

By Richard V. Dragan

Let's admit it right up front: Code editors are not for regular users. They're for us programmers, a cantankerous bunch who are known for odd loyalties when it comes to the tools of our trade. As long as code-free programming remains a pipe dream (rapid application development tools, prebuilt objects, Experts, and Wizards notwithstanding), the editors reviewed in this article can help you get your code written in the most individual, flexible, and fastest way possible.

Code editors provide the ultimate in customization. If you don't like what a keystroke does, remap it. If you have a favorite tool to run while you program, add it to the environment and make it your own. Code editors foster, and demand, a roll-up-your-sleeves approach to designing your own workspace.

Do you still need a standalone editor in this day and age? Admittedly, a recent trend working against third-party code editors is the vast improvement we've seen in the quality of integrat-

IN THIS SECTION



TUTOR *Multithreading* is a term you hear a lot these days, but what exactly is a thread? Jeff Prose explains threads, explores how they are preemptively multitasked by today's 32-bit operating systems, and illustrates how they can benefit you in real applications. *page 379*



POWER PROGRAMMING The addition of support for forms in HTML 2.0 now makes it possible to create interactive applications for the World-Wide Web. Ray Duncan begins a multipart series on interactive forms-based Web apps with a look at the HTML tags used for creating forms containing text-entry boxes, buttons, check boxes, and list boxes. *page 391*



INTERNETWORKING SMTP. POP, X.400, and IMAP are the workhorse protocols of Internet mail. Choosing the right one for your network means understanding how each is adapted to your security needs, level of e-mail traffic, and type and number of mail hosts. *page 407*

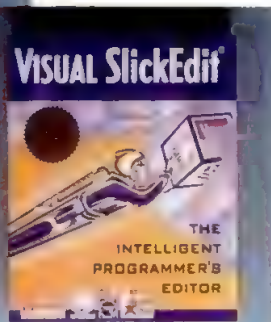


SPECIAL REPORT CD-Quick Cache, the winner of the Ziff-Davis 1995 Shareware Awards, is a CD-ROM caching utility for DOS and Windows 3.1 that dramatically outperforms Microsoft's SmartDrive in applications that demand random data access. We look at how CD-Quick Cache works and how you can obtain a copy for yourself. *page 410*



LAB NOTES With this issue, *PC Magazine* inaugurates its latest benchmark tests: Winstone 96 and WinBench 96. We look at what's new in the latest releases of these industry-standard benchmark tests, how they work, where you can obtain them, and how you can use them to best advantage on your own hardware. *page 420*

ALSO IN THIS ISSUE PC Solutions looks at command line switches for troubleshooting Windows 3.1, an easy trick for copying entire directory structures using PKZIP, ways to protect your equipment from a lightning strike to phone lines, and more. *page 429*



A QUARTET of powerful code editors that demand more up-front work than an IDE but pay you back with extensive customizability, powerful macro capabilities, and access to version control.

ed development environments (IDEs) provided by the major C/C++ development systems. For example, Borland, Microsoft, and Symantec offer wizard-style approaches to C++ code management that can take the bite out of creating new projects. All offer editing (with syntax highlighting), compilation, and debugging under one roof.

But there are still plenty of cases where an IDE's built-in tools may not be the best ones. In the real programming world, you may be using several languages and managing builds with a myriad of tools. Here's where the true beauty of a strong code editor becomes apparent. The products in this article all help you to manage a variety of languages and build options.

If you're an IDE programmer, it is tempting to ignore the intricacies of using .MAK files for building your projects. After all, the big IDEs let you automate compiler switches to generate debug and release versions of your code. But the fact remains that, to achieve the highest level of control over builds for any project, you will need to wield some .MAK file expertise. The code editors reviewed here all offer command line control of your compilers. As such, they can act as custom IDEs and, if configured correctly, excellent build managers.

Standalone code editors offer other strategies for making your programming life as comfortable as possible. Their open and customizable help systems let you add Windows help files from your compiler or other source to the editor; these are parsed and brought up with hypertext links intact. This way, you don't have to forgo the language-specific ex-

editors also offer powerful macro languages that let you design and create dialog boxes and even whole new add-on modules. (If you're willing to do the work, it would even be possible to emulate a wizard-based approach to code management using macro programming.) They also let you use the version-control software of your choice from within the editor, a must for even the smallest programming shop. While none of the packages reviewed here provides its own version-control software, most provide easy hooks into well-known packages.

With all the editors we saw, it's a mark of pride that everything is customizable. Still, there are plenty of distinctions among them, and certain options will be easier to customize in one rather than another. You'll want to know how easy it is to alter keystroke mappings, change syntax highlighting, and even add new language elements.

INTEGRATION STRATEGIES

Code editors can take two basic approaches toward integrating with your compiler. One is to work within an existing IDE so that instead

of using the IDE's default editor, you replace it with a much more powerful one. Despite its attractions, this approach involves considerable difficulties due to the complexity of today's C++ IDEs. A code editor needs to be tightly coupled to the IDE in which it operates, and all indications are that the compiler vendors are not terribly interested in creating open environments for plug-in code editors. Only one product reviewed here, Premia's

Codewright Fusion, adopts this approach, and the only compiler it supports is Microsoft Visual C++ 2.x.

A much more simple and inherently more flexible strategy for getting a code editor to work with a compiler is to use the command line version of the compiler and buffer its out-

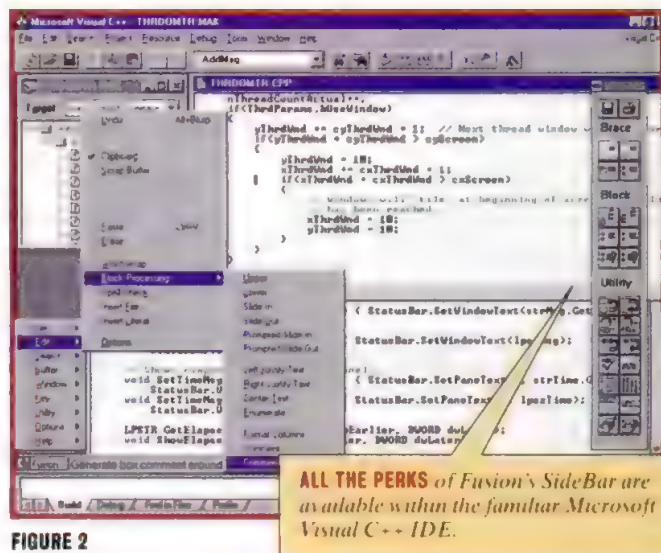


FIGURE 2

put to a window in the editor. With today's multitasking environments, this approach is even more powerful, since your build can run in the background. Such a run-and-buffer approach is the cornerstone of managing builds within most code editors. You can run any program (compiler or otherwise), as long as it can be controlled through the command line and sends its output to the screen or disk. The ability to trap this output makes a code editor effectively language-independent. Admittedly, this strategy requires expert knowledge of .MAK files and build options. If you've never looked at a .MAK file before, you have some work to do, but the rewards are potentially great.

The best code editors offer software creation with a personal touch. While they may offer no initial out-of-box configuration at all, a few hours invested in customization can result in fewer keystrokes and an individual stamp on your desktop that will make you far more productive in the long run.

Richard V. Dragan is a programmer for PC Magazine Labs and teaches C++ programming at Columbia University.

Premia Corp.

Codewright Professional for Windows NT Codewright Fusion for MSVC++

Will customizable code editors hold their own against ever-smarter and feature-rich compiler IDEs? Premia Corp. is betting on both sides of the table with two versions of its powerful Codewright code editor. Codewright Professional 3.1h for Windows NT is an appealing standalone product designed to run under Windows NT 3.1 and later

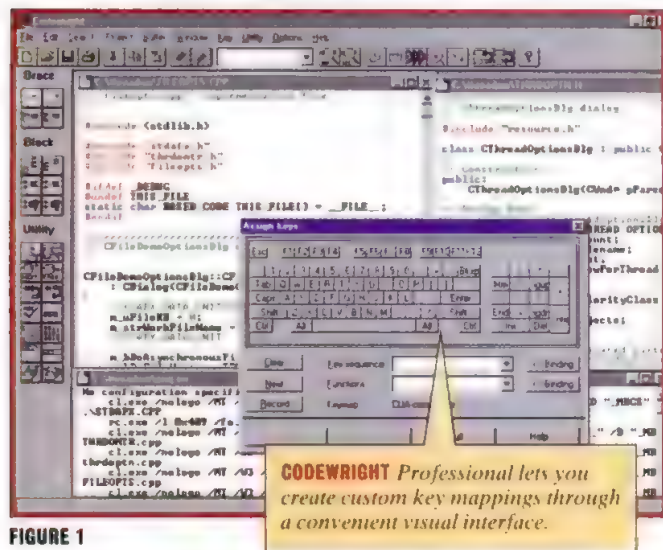


FIGURE 1

pertise included with your original compiler. Just hit a button and you get on-line help for language elements, whatever that language happens to be.

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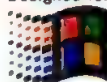


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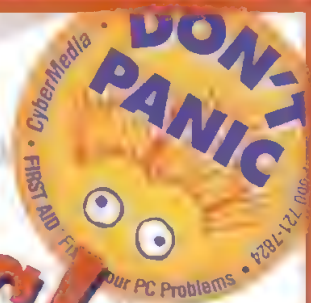
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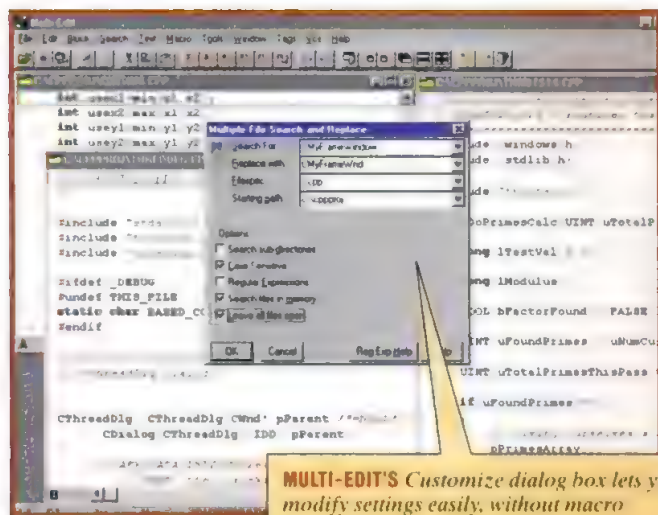


FIGURE 3

(it also ran without problems under Windows 95 in our tests). Codewright Fusion for MSVC++ is a dedicated add-on for Microsoft Visual C++ 2.x that consists of two products: the 16-bit Version 1.5 for Visual C++ 1.5 and the 32-bit Version 2.0 for Visual C++ 2.0.

STRONG STRAIGHT OUT OF THE BOX

Codewright is strong on built-in functionality right from the beginning. Key mappings for Brief, Epsilon, and vi emulation are instantly available, and you can use a handy graphical interface to change key mappings at will (see Figure 1). For extensive key remapping, you'll find that modifying the program's .INI file is a more efficient method, however.

As an editor, Codewright Professional performed with fewer capacity limitations than any of the other packages reviewed here. It loaded a 50MB text file with minimal use of virtual memory and allowed us to scroll through 5 million lines of text effortlessly. Though your C/C++ source files are likely to be far smaller, Codewright Professional's ability to handle large files will be appreciated by programmers who find themselves needing to load larger and larger database or .EXE files (you can view binary data in hex mode).

Codewright Professional also makes programming simpler right out of the box. The SideBar toolbar lets you match braces, indent code, and create comment and function-header comment blocks very quickly. You can also easily search across files in memory or on disk. Another feature, selective editing, is a great plus. This capability lets you view only the code between C preprocessor statements (like #ifdef and #endif) used for conditional compilation. While preprocessor statements are widely used to allow code to be compiled across multiple platforms, they can quickly lead to unintelligible code. Codewright makes this powerful programming technique much

more manageable and easier on the eyes.

Syntax highlighting, which Premia aptly calls *chromacoding*, is supported for assembly language, C/C++, COBOL, Paradox, Pascal, Visual Basic, and xBase right out of the box. Other language modules, available as free downloads from Premia's BBS, include ADA and HTML. Of course, you can also add new keywords, change colors within the environment, or customize it in al-

most any way imaginable. This involves editing the program's .INI file and using an encyclopedic library of more than 850 documented (and many more undocumented) C functions collectively known as the Codewright API.

Be forewarned: You'll need to know C and be familiar with the Windows API, since many of the Codewright API functions encapsulate Windows calls. But with a little imagination, you'll be able to develop substantial add-ons to the Codewright Professional environment. The power of this approach is demonstrated by the wide range of modules available for downloading, which include some for very specific languages. A Codewright Professional companion disk includes a number of sample downloads, including several useful utilities to help you migrate existing projects into Codewright. But you don't need to compile anything to customize Codewright. A large subset of the Codewright API, those functions that don't return values, can be used in its .INI file to create new language modules.

Codewright Professional's support for plain old macros is less impressive. Though you can record and play back macros and change key assignments, you can't edit macros. The good news is that another feature, language templates, lets you automatically create skeleton code outlines for many common language elements (say, a C switch statement or default class definition complete

with brackets) using only a few keystrokes. Language templates are a good way to extend the environment with your favorite custom shortcuts.

Other customization options include the ability to hook version control packages—provided they work with a command line interface—into the Check In and Check Out menu options. It's also simple to add existing help files to Codewright Professional's help system so that you can transplant support for your languages and compilers of choice into your editor.

CODERWRIGHT FUSION

Suppose you don't want to give up the Wizard tools you've come to love in your compiler? The answer, at least for Microsoft Visual C++ programmers, is Codewright Fusion, an add-on specifically for Microsoft Visual C++ 2.x (the package also includes a 16-bit version of Fusion for use with the 16-bit Microsoft Visual C++ 1.5 included in the Visual C++ 2.x bundle).

Fusion gives you many of the same features as Codewright Professional, but from within the Visual C++ IDE. You access them through a button resembling Windows 95's Start button that appears at the bottom of your screen any time you open a source file. Since Codewright relies on Visual C++ to create its edit buffers, Fusion won't give you the same ability to edit large files as you get with the standalone product. But you will get almost everything else.

Visual C++ treats the text inside each Codewright buffer as its own, so you can still use the Visual C++ ClassWizard as a guide to your code. The advantage is that you also

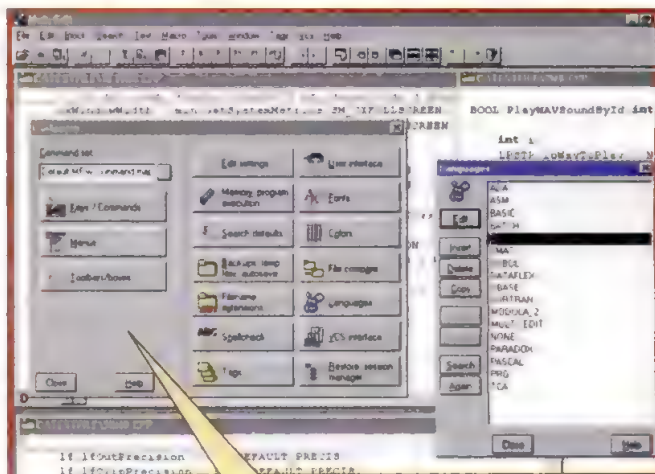


FIGURE 4

A BETTER GREP: Multi-Edit lets you easily search and replace on multiple files in memory and on disk.

have access to Codewright perks, from advanced searching, braces, and blocking, to language templates and a spell-checker. The SideBar of the standalone product becomes a floating toolbar that offers the same options (see Figure 2). Importantly, you can still access your version control package from

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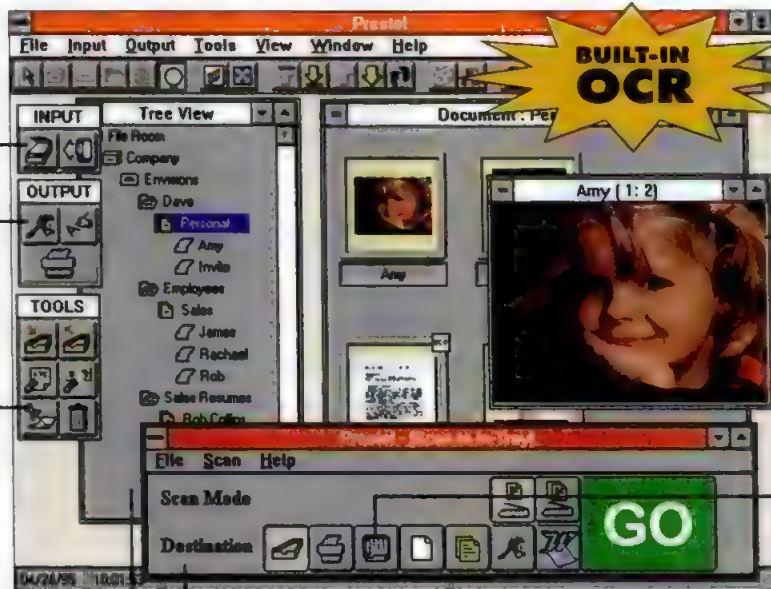
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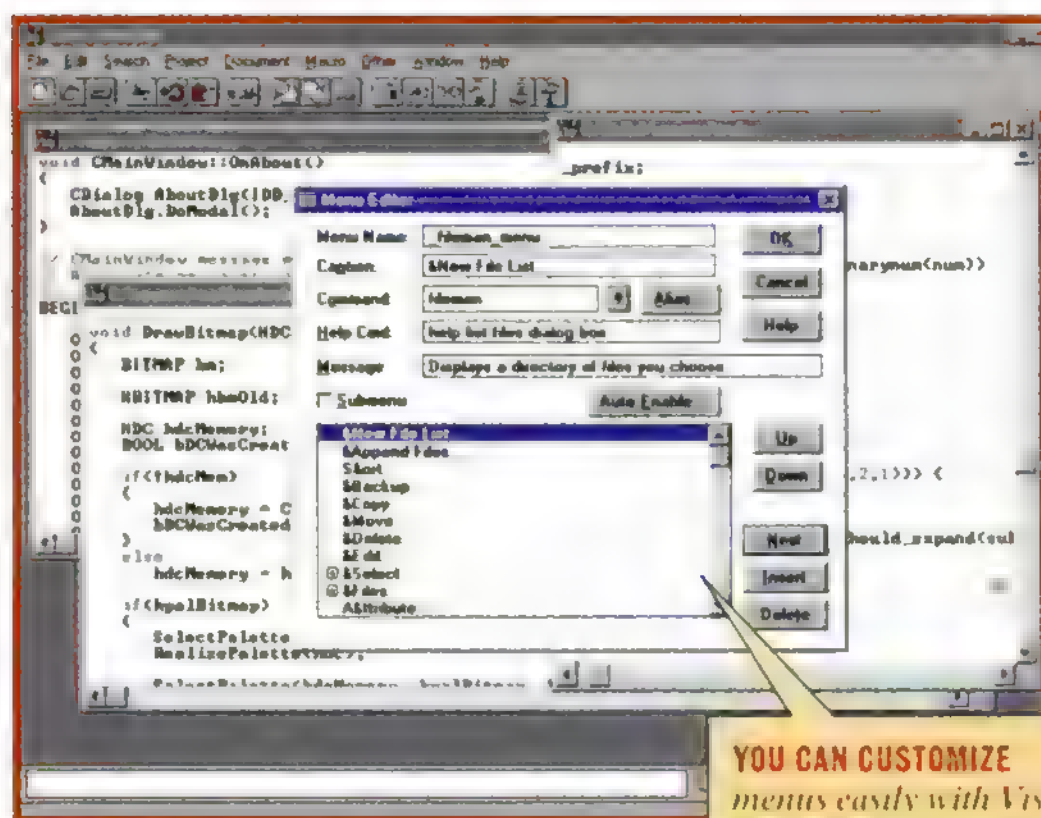


FIGURE 5

within Visual C++ using Fusion. Visual C++ manages builds and error parsing.

You can use existing Codewright extensions written to the Codewright API, provided they are recompiled for use with Fusion. You can also add functionality to Fusion by adding .INI file settings using many of the functions in the Codewright API. If you need to maintain multiple language modules from within Visual C++ or need third-party version control, Fusion can simplify your life considerably while still giving you access to Visual C++ Wizards and other tools.

With its winning combination of out-of-box functionality, an open and customizable architecture, and a thriving bulletin board with free add-ons, Codewright continues to be a highly appealing choice. With the Fusion product, even students and other less-than-guru programmers will be tempted to see what a real programmer's editor can offer, without having to give up the familiar turf of the Visual C++ environment.

Codewright Professional 3.1h for Windows NT. List price: \$229. Requires: Microsoft Windows NT 3.1 or later or Microsoft Windows 95.

Codewright Fusion for MSVC++. List price: \$149 (includes both 32-bit and 16-bit versions). Requires: Microsoft Windows NT 3.1 or later or Microsoft Windows 95, Microsoft Visual C++ 2.0 or later. Premia Corp., Portland, OR; 800-547-9902, 503-641-6000; fax 503-641-6001.

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American Cybernetics

Multi-Edit for Windows

Multi-Edit for Windows 7.0 is an admirably efficient programmer's editor that ships on a single disk. With its full-feature set and easy-to-handle configuration options, Multi-Edit proves that even today, powerful functionality is still available inside a remarkably small footprint.

The core features of Multi-Edit's editor are right on target. Out of the box, Multi-Edit comes with Brief and Wordstar editor emulations, and adding your own custom key mappings is very easy. It also offers respectable support for loading large files. Under Windows 95, we were able to open a 50MB text file for browsing; although scrolling proved slow, the program remained usable. Multi-Edit also lets you

search multiple files both in memory and on disk (see Figure 3).

Perks include a built-in calculator with hex, octal, binary, and decimal support. There's also a spell-checker, an ASCII lookup table, and a nifty notebook feature that lets you organize project notes grouped by lists of categories.

EASY TO MAKE YOUR OWN

While all the programmer editors reviewed here are highly customizable, Multi-Edit makes it exceptionally simple to personalize the environment without having to resort to its macro language. A single Customize dialog box is your command center for controlling the entire Multi-Edit environment (see Figure 4). This dialog provides an attractive interface with multiple buttons to manage the more common settings (changing key mappings, menu options, and toolbars) as well as the more advanced settings.

You can easily set up a compiler for C by selecting the Languages button and choosing the C language option. Other supported languages include assembly language, Basic, COBOL, dBase, Fortran, Modula 2, Paradox, Pascal, and PRG. For C/C++ programmers, there are built-in compiler options for Borland, Microsoft, and Watcom C/C++ development systems. There's no getting around the intricacies of .MAK files, but Multi-Edit might get you started a little more quickly.

Syntax highlighting is easy to customize. You can define new languages and new keywords without modifying .INI settings. Just choose the Languages button, select an existing language or add a new one, and then type new keywords into a dialog box.

The same configuration dialog box approach lets you set up version control software. Like the other applications in this review, you can plug in packages that permit command line calls to check in and check out source files.

You can also change almost everything

about the Multi-Edit environment programmatically. The macro language to do this is CMAC, which uses C language conventions and a library of several hundred function calls to customize and extend the Multi-Edit environment. CMAC scripts use the .S extension, and macros are compiled using the CMAC-WIN.EXE utility. The environment also readily supports debugging macros. You can inspect variables as you debug programs.

Multi-Edit for Windows is a 16-bit executable that runs safely under Microsoft Windows 95 and Microsoft Windows NT. American Cybernetics has promised a Windows 95-specific version by the first quarter of 1996.

If you're interested in a small-footprint programmer's editor that doesn't take a lot of time to customize—yet offers extensive customization when you need it—take a look at this efficient and powerful package.

Multi-Edit for Windows 7.0. List Price: \$199. Requires: Microsoft Windows 3.1, Microsoft Windows 95, or Microsoft Windows NT. American Cybernetics, Tempe, AZ; 602-968-1945; fax, 966-1654.

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Visual SlickEdit Graphical Edition

Visual SlickEdit is a full-featured, highly programmable code editor available for an impressive array of hardware and software platforms—everything from Windows systems to RISC-based minicomputers. The Visual SlickEdit 7.0 Graphical Edition bundle reviewed here includes both a 32-bit version for Windows 95 and Windows NT, and a Win32s version for Windows 3.1. A solid GUI implementation of an already-strong editor makes Visual SlickEdit 7.0 a strong entry in the Windows field. A Visual SlickEdit Graphical Edition release for OS/2 is also available.

MULTIPLE EMULATIONS, MULTIPLE LANGUAGES

Visual SlickEdit gets you up and running quickly with built-in Brief, EMACS, and vi editor emulations. If you have your own views as to how a keyboard should be used, you can easily remap any and all keystrokes with the Key Bindings option.

Visual SlickEdit gives you built-in syntax highlighting for an impressive array of languages including Ada, assembly language, C, C++, COBOL, dBase, FORTRAN, Modula-2, Pascal, Visual Basic, and the product's native Slick-C macro language. With just a little effort, you can customize the highlight colors or add new elements to the highlighting scheme by creating entries that are stored in a VSLICK.VLX file. This feature also lets you create full custom-coloring schemes.

Syntax expansion, another useful feature,

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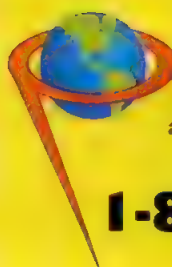
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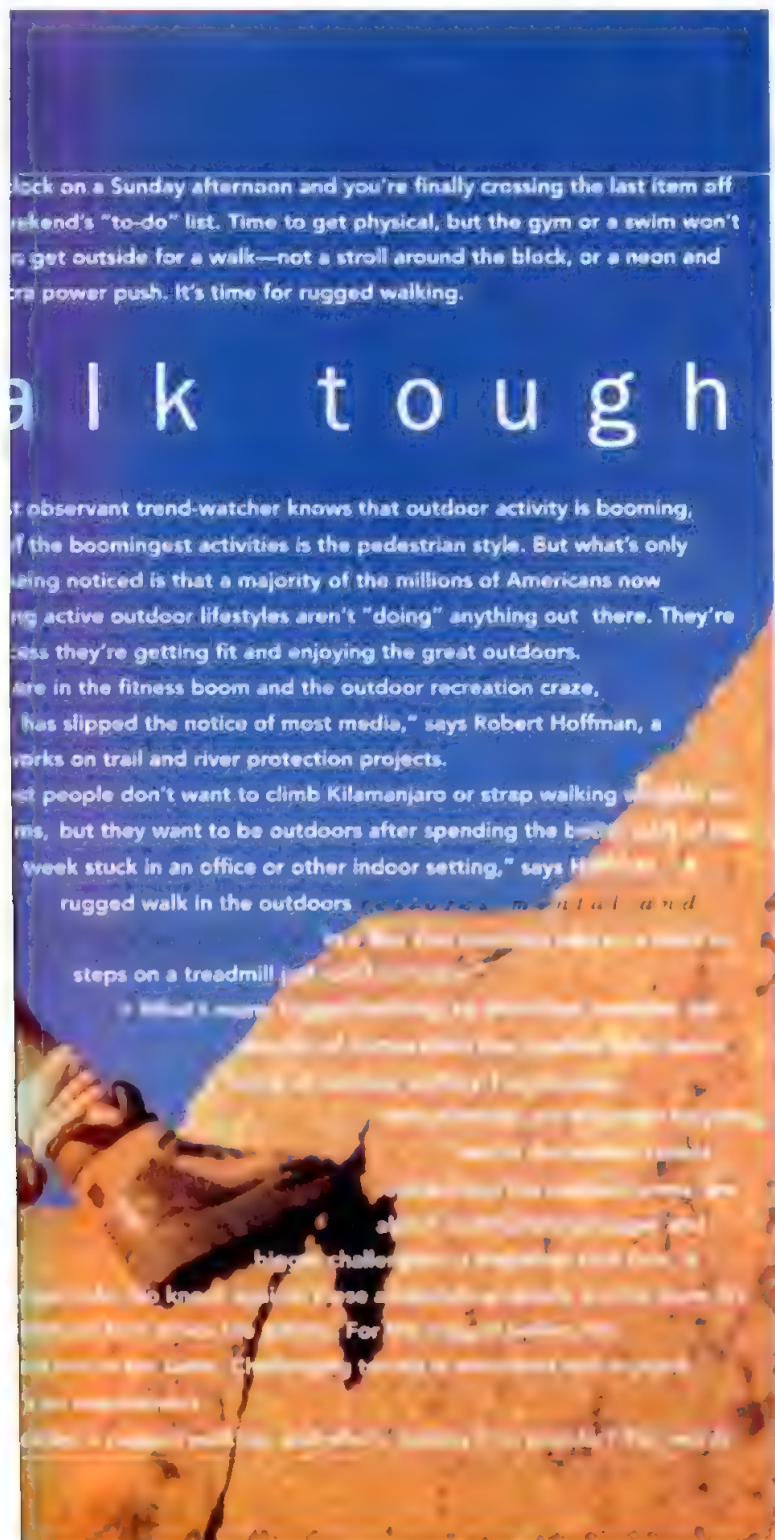
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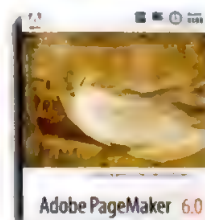
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tomization, you'll want to do some Visual SlickEdit programming, and here too you'll find that the product has a lot to offer.

Perhaps Visual SlickEdit's most outstanding feature is its Slick-C macro language, which

isting forms can be reused with *clipboard inheritance*, a clever feature that allows you to copy controls and the code attached to them to new forms using the clipboard.

Slick-C macros are compatible across the line of Visual SlickEdit products for other environments besides Windows. In an era where cross-platform development is still an important issue, especially in corporations, being able to leverage your macros in multiple environments is an appealing feature. If you want to keep things simple, you can also record macros without knowing anything about Slick-C.

In short, Visual SlickEdit is a complete programmer's editor, powerful straight out of the box and highly customizable with its sophisticated macro language. Its excellent compatibility with other SlickEdit releases on other platforms will be of particular interest to programmers who code in several environments.

Visual SlickEdit 7.1 Graphical Edition. List price: \$295 (includes 32-bit and Win32s versions). Requires: Windows 3.1, Windows 95, or Windows NT 3.x and above. microEdge Inc., Raleigh, NC; 800-934-3348, 602-966-1654; fax, 602-968-1945.

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WinEdit 32

As an editor, WinEdit is clearly up to par. Its built-in syntax highlighting supports assembly language, Basic, C, C++ DCL, Lisp, Modula2, and xBase, as well as its own macro language, the Windows Interface Language (WIL). You can add blocks for If-Then, Switch, and While constructs and comment blocks tailored to each language. Changing keyword highlighting or adding support for new language keywords and color coding involves making changes to an .INI file. Each supported language uses its own small .INI file and you can add your own. The method is straightforward and will not be difficult for anyone familiar with programming.

In theory, the size of edited files is limited only by system memory. We experienced considerable disk thrashing while loading a 50MB file on a test system with 16MB of RAM, but were able to load and edit a more realistic 2MB file with ease.

We did find a few quirks in the editing environment. Although a Grep facility is built into WinEdit, the search mode will not let you search across files. And instead of offering specialized rewrites of existing system utilities, WinEdit gives you menu access to regular Windows accessories like Calculator and Paint.

For building projects, the news is better. WinEdit offers build options for several popular compilers and languages including

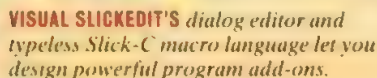


FIGURE 6

For maintaining groups of source files, Visual SlickEdit uses .VPJ project files. It offers build options for Borland C++ and Microsoft Visual C++, but you'll probably still want to set your favorite build options yourself.

You can handle reasonably large source files using Visual SlickEdit. The theoretical file size limit is 1GB, and we were able to load a 50MB text file successfully (albeit with considerable disk-thrashing, even on a system with 16MB of RAM). The product handled a more realistically sized 2MB file effortlessly on the same test system.

The editor itself includes many fine extras like a spell-checker, a calculator (with binary and hex support), an ASCII table, and buffer-sort and file-compare capabilities. You can search across multiple files in memory and on disk using the built-in GREP-like search capabilities.

The product offers built-in hooks for accessing version control software packages including InterSolv's PVCS. You'll need to make sure your version-control package supports control through a command line interface, though. The Check-In and Check-Out options are easily accessed through a menu.

Like the rest of the programming editors here, Visual SlickEdit offers a fully customizable environment. You may find the Configuration dialog a little overcrowded, but there's no denying the control it gives you over virtually every aspect of the editor. For example, SlickEdit's Menu Editor tool lets you customize menu options within the environment using an interface similar to that of Visual Basic (see Figure 5). For more advanced cus-

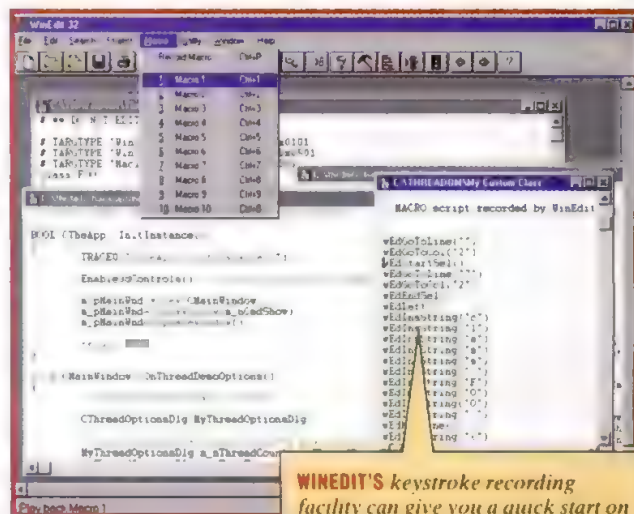
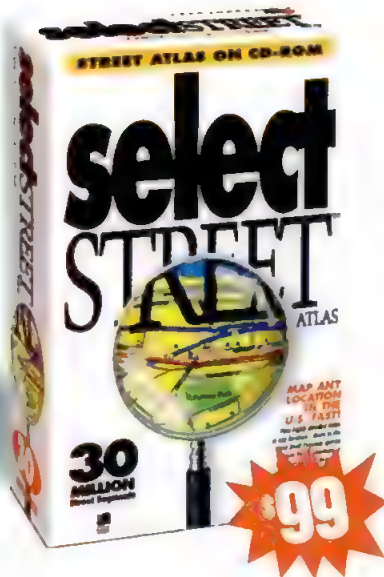


FIGURE 7

WINEDIT'S keystroke recording facility can give you a quick start on creating your own macros.



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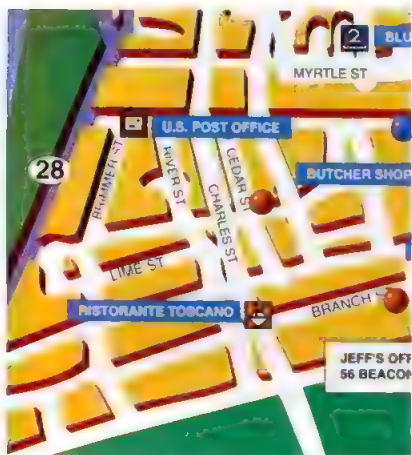
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assembly language, Borland C++, Clipper, Microsoft Visual C++, and Pascal. It's also easy to customize the way WinEdit parses error information from your compiler. Further, you can add to the list of help files used to provide context-sensitive help. By default, the environment recognizes the Windows API and Microsoft C/C++ help keywords, as well as those for writing WIL macros.

WinEdit does not come preloaded with editor emulation styles. You can readily change default key assignments, however. Menus can also be changed, although this requires a little more work than it does in the other products reviewed here.

To add menu items, you'll need to write a script using WIL, WinEdit's native macro language. For Windows programmers, however, this will be as easy as creating a resource script file that defines a menu. When you define a new menu item—for example, a run command—you can also define the action it invokes, so the extra effort needed to create a menu turns out to be a good idea.

WIL is by far the most ambitious element of WinEdit and includes more than 550 functions. It is an interpreted language and bor-

rows syntactical elements of C (for instance, its use of '==' and '=' for the equality and assignment operators) as well as Visual Basic

WIL, an interpreted language that borrows syntactical elements of C and Visual Basic, is by far the most ambitious element of WinEdit.

(its flow-control statements, for example). WIL aims to be a full-fledged batch language (akin to REXX) that allows programmers to control Windows applications in an agent-based manner. Not only can you run applications, but you can wait until they finish, process results, and so forth. Significantly, you can send keystrokes and other events from

macros to other applications. Controlling processes has always been a problem in the Windows family of operating systems. WIL seeks to fill that gap, and it offers many functions that have the potential to do just this.

Getting started in simple macro programming is no problem in WinEdit, because you can record macros, edit them as a series of WIL statements, and then attach them to the default menu (see Figure 7). Or you can execute individual WIL macro commands in interactive execution mode. Many of the WIL commands can be used to create menus. Others must be used in standalone scripts.

For programmers who need control over many different processes and who don't mind performing some extra chores under the hood, WinEdit's capable programmer's editor and excellent batch language offer strong potential for building a productive custom programming environment.

WinEdit 32, Version 3.1. List price: \$129.95. Requires: Microsoft Windows NT 3.1 or better, or Microsoft Windows 95. Wilson WindowWare Inc., Seattle, WA; 800-762-8383, 206-938-1740; fax, 206-935-7129.

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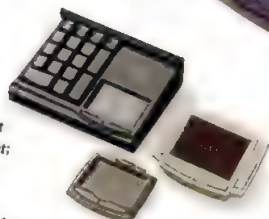


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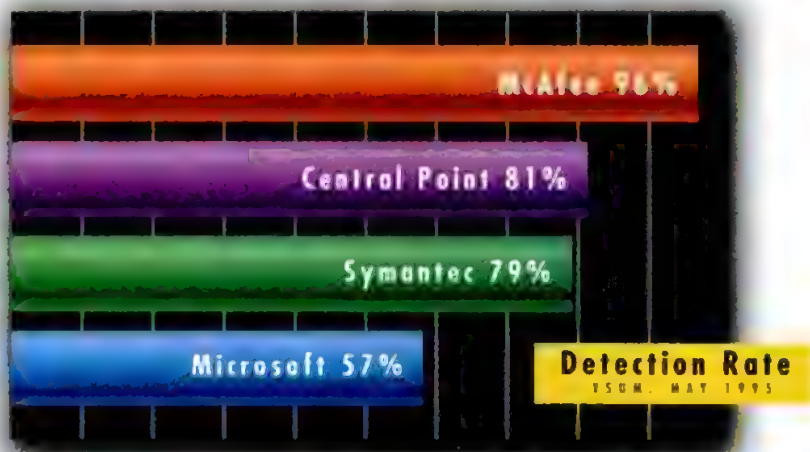
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By Jeff Prosis

What's in a Thread?

What makes the new 32-bit operating systems *multithreaded*?

Multitasking and multithreading are two terms often used to describe 32-bit versions of Windows and OS/2. A multitasking operating system allows two or more applications to run concurrently by dividing processor time between them. Multithreading means that the operating system supports multiple concurrent threads of execution within a single application.

Most of us understand well enough what multitasking is, but who among us could explain to a colleague the true meaning of multithreading? What, for example, does *multiple concurrent threads of execution* mean? What is a thread of execution?

How does multithreading differ from multitasking, and how, if at all, are the two related? More important, what difference does multithreading make to an application? Do multithreaded Windows programs run better than single-threaded versions, or is multithreading something that only a techie could love?

These are complex questions. Fortunately, the answers don't have to be complex. It's not necessary to be a Windows programmer to understand what threads of execution are and how they're used. In the pages that follow, we'll define the term *thread* and discuss how threading is implemented in Windows 95 and Windows NT.

We'll examine how threads are used both by application programs and by the operating system itself. Finally, we'll look at two versions of an application program—one that's multithreaded and one that's not—to see firsthand how much or how little difference multiple threads of execution make.

THREADS: THE ATOMIC UNIT OF EXECUTION

In Windows 3.x, each instance of a running application program constitutes one *task*. The operating system divides the CPU among tasks, using a cooperative scheduling mechanism that relies on each application to yield processing

time to others. Scheduling is performed on a per-task basis, so switching from one task to another basically means that Windows saves the CPU registers for the task that is losing activation and restores the register values last saved for the task being switched to. It then begins executing code where that task left off.

In the Win32 environment, we no longer think of programs in terms of tasks, but rather in terms of *processes* and *threads*. A process is one instance of a running application and all the memory and other resources associated with it. A thread is one path of execution through the application's code. A process can consist of one thread or it can consist of many. Processes and threads are preemptively multitasked, so it's no longer necessary for one application to yield so that others can get processing time. Instead, the operating system

uses a sophisticated scheduling mechanism to forcibly interrupt, or *preempt*, the currently active thread when it's time for another to get a turn. This produces a smoother form of multitasking that distributes time more fairly among applications and makes all applications more responsive to input when several are running at once. Responsiveness is important, because a sluggish mouse or keyboard is the first thing a user will notice if an application doesn't perform up to standards.

To put the difference in perspective, think of each task in 16-bit Windows as a single thread of execution. The program is executed in a linear fashion, from top to bottom, following the path represented by the thread. In 32-bit Windows, a process starts life as a single thread, but it can spawn additional threads to perform background tasks such as formatting a disk or

recalculating a spreadsheet. Each thread is like a fork in the road describing a path for the CPU to follow, and each path is executed (and multitasked) independently, as if it were a separate program.

By splitting CPU time among concurrent threads, Windows 95 and OS/2 create the illusion that the threads run in parallel. On a machine with multiple CPUs, Windows NT really does run two or more threads at the same time by assigning different threads to different processors. This feature is known as *symmetric multiprocessing*, or SMP. PCs with two or more CPUs are novelties today, but in a few short years we'll all be running 4 to 16 processors in a box. And when we do, we'll all want SMP.

In Windows 95, as in Windows NT and OS/2, it is the thread, and not the process or task, that is the atomic unit of execution. If an application wants to do several things at once, it can simply dedicate a thread to each. The operating system then makes sure that each thread gets the CPU time it requires. A 16-bit application, by contrast, can carry out two operations at once only if it contains special—and

Single vs. Multiple Threads of Execution

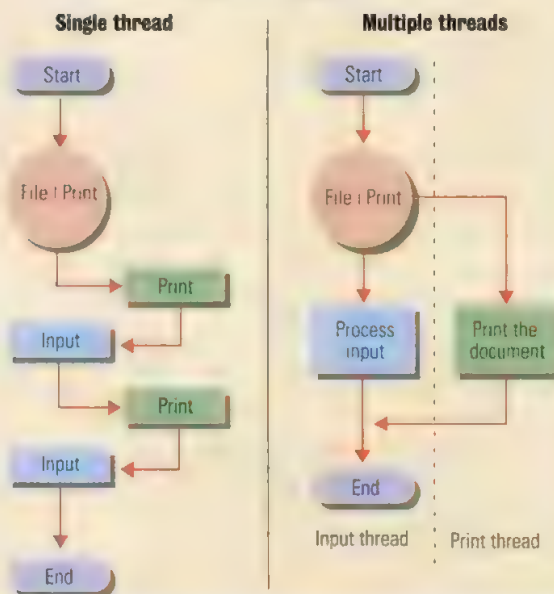


FIGURE 1: Confronted with the task of printing a document while remaining responsive to user input, a multithreaded application can delegate the printing process to a separate thread of execution. The input thread and print thread then run in parallel until printing is completed. A single-threaded application, by contrast, must alternate between printing and checking for user input, which slows down printing and decreases responsiveness.

usually very tricky—code to alternate between them. This usually means that each operation must be subdivided into smaller pieces that can be performed alternately. It also means that if one piece of one operation takes longer than it should to execute, the

that thread is running, the operating system switches rapidly between the input thread and the print thread so that both appear to be running at once. Moreover, each thread is utilized with maximum efficiency. While the input thread awaits input, the print thread receives the lion's share of the CPU. But as soon as the user presses a key or clicks a mouse button, the print thread is preempted and control is transferred back to the input thread. No time is wasted waiting for input, but when an input event occurs, the program responds immediately.

Ever notice how difficult it is to do meaningful work while the Windows 3.1 Print Manager prints a large document? Now you know why: Print Manager isn't able to do its printing in a separate thread. Instead, it has to print a few characters, yield, print a few more characters, yield, and keep repeating this process until printing is completed. Typed characters and other input wait in line for processing behind chunks of data transmitted to the printer. In Windows 95, Windows NT, and OS/2, however, background printing is demonstrably less intrusive, in part because print spooling is performed by a dedicated thread that is preempted by input events. This is clear evidence of the difference that multithreading can make.

THREAD SCHEDULING

For the operating system, deciding which thread to execute next and how long to let it run is a complicated process involving many factors. It's not just a matter of setting a timer to fire every few milliseconds and activating each thread in turn. Such a system would offer little improvement over the 16-bit systems we're used to today.

The primary consideration in scheduling threads for execution is each thread's *execution priority*. Windows 95 and Windows NT assign each thread a priority value from 0 to 31, with higher numbers indicating higher priority. Priority 31 is reserved for extremely critical tasks such as real-time data acquisition, while priority 0 is used by the operating system for certain idle-time tasks that are performed only when nothing else is going on. Most threads run at priority levels from 7 to 11. Every few milliseconds, the operating system's scheduler

evaluates all the threads in the system and allocates processor time to the one with the highest priority. If two or more threads have equally high priority, the one that has been executed least recently is executed next. In general, high-priority threads are always executed before low-priority threads, and threads with low priority never preempt threads with high priority.

Does this mean that if a priority-10 thread is executing in the system along with four priority-9 threads, the priority-9 threads will never execute? Not at all. Remember, in Windows everything is message-based. A Windows application doesn't process mouse and keyboard input directly; rather, it receives messages from the operating system informing it that a mouse or keyboard event has occurred. If the priority-10 thread empties its message queue—that is, if there is nothing more for it to do until another message comes along—it is suspended so that lower-priority threads can execute. A suspended thread receives no processor time until something wakes it up. When the sleeping priority-10 thread receives a message, it will wake up and preempt a priority-9 thread that is currently executing. Until then, it consumes zero processor time. Most threads spend a lot of time in a suspended state waiting for input events, so in all but the most extreme cases even priority-0 threads get ample time to execute. Nonetheless, a poorly written application can still bring the rest of the system to a crawl. Fortunately, poor threading design is very obvious in testing, and most software makers iron out the performance problems before shipping.

Windows 95 plays a lot of tricks with priority levels to make applications as responsive



FIGURE 2: The System Monitor supplied with Windows 95 displays thread counts as well as other interesting statistics about the system.

other half of the program loses out on needed processor time. If the half that gets short-changed is the one that reads and processes input from the user, the application will suddenly seem sluggish and unresponsive.

The diagram in Figure 1 illustrates the difference between single and multiple threads of execution in two hypothetical word processing programs. At one point in each program, the user selects Print from the File menu and the application begins sending the document to the printer. Printing is done in the background, so the user can continue typing.

First, consider the single-threaded application on the left. When printing is begun, the application begins alternately checking for input and sending data to the printer. The program logic is complicated because the printing process must be broken into steps and performed one step at a time. Worse, the application's responsiveness suffers, because mouse and keyboard events are accorded no priority over the printing process. If the user presses a key right after the application begins printing a block of data, the event languishes in an input queue until the application turns its attention away from the printer. Input latencies can be reduced by breaking the printing process into smaller pieces requiring less time to execute, but that, too, has its drawbacks: More time devoted to checking for input means more time needed for printing.

In the multithreaded application, background printing is no big deal; the program starts a second thread, whose sole purpose is to output the document to the printer. While

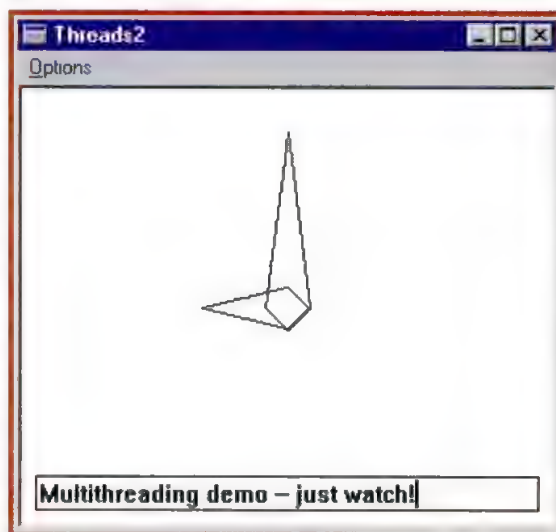


FIGURE 3: Threads2 uses three threads of execution: one to process user input, a second to spin the hands of the clock continuously, and a third to walk the directory structure of your hard disk counting files and directories—all at the same time.



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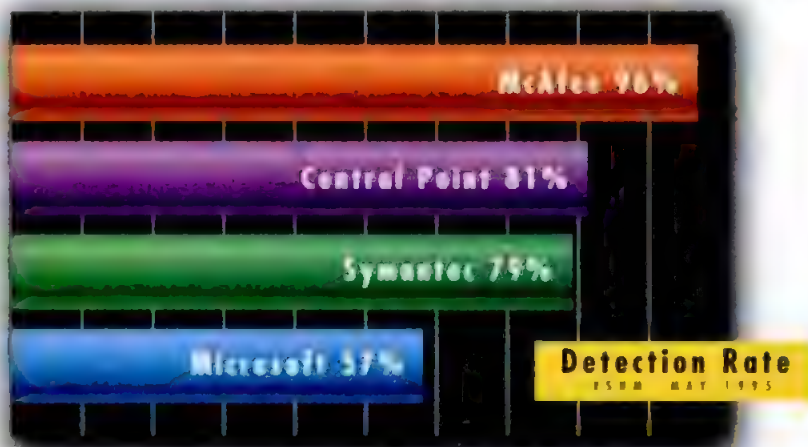
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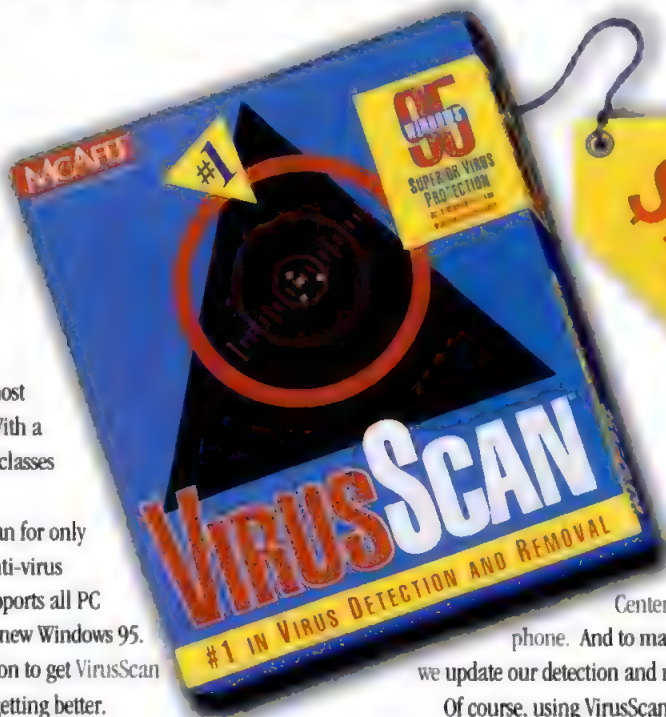
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PC Tech/Tutor

By Jeff Prosis

What's in a Thread?

What makes the new 32-bit operating systems *multithreaded*?

Multitasking and multithreading are two terms often used to describe 32-bit versions of Windows and OS/2. A multitasking operating system allows two or more applications to run concurrently by dividing processor time between them. Multithreading means that the operating system supports multiple concurrent threads of execution within a single application.

Most of us understand well enough what multitasking is, but who among us could explain to a colleague the true meaning of multithreading? What, for example, does *multiple concurrent threads of execution* mean? What is a thread of execution?

How does multithreading differ from multitasking, and how, if at all, are the two related? More important, what difference does multithreading make to an application? Do multithreaded Windows programs run better than single-threaded versions, or is multithreading something that only a techie could love?

These are complex questions. Fortunately, the answers don't have to be complex. It's not necessary to be a Windows programmer to understand what threads of execution are and how they're used. In the pages that follow, we'll define the term *thread* and discuss how threading is implemented in Windows 95 and Windows NT.

We'll examine how threads are used both by application programs and by the operating system itself. Finally, we'll look at two versions of an application program—one that's multithreaded and one that's not—to see firsthand how much or how little difference multiple threads of execution make.

THREADS: THE ATOMIC UNIT OF EXECUTION

In Windows 3.x, each instance of a running application program constitutes one *task*. The operating system divides the CPU among tasks, using a cooperative scheduling mechanism that relies on each application to yield processing

time to others. Scheduling is performed on a per-task basis, so switching from one task to another basically means that Windows saves the CPU registers for the task that is losing activation and restores the register values last saved for the task being switched to. It then begins executing code where that task left off.

In the Win32 environment, we no longer think of programs in terms of tasks, but rather in terms of *processes* and *threads*. A process is one instance of a running application and all the memory and other resources associated with it. A thread is one path of execution through the application's code. A process can consist of one thread or it can consist of many. Processes and threads are preemptively multitasked, so it's no longer necessary for one application to yield so that others can get processing time. Instead, the operating system

uses a sophisticated scheduling mechanism to forcibly interrupt, or *preempt*, the currently active thread when it's time for another to get a turn. This produces a smoother form of multitasking that distributes time more fairly among applications and makes all applications more responsive to input when several are running at once. Responsiveness is important, because a sluggish mouse or keyboard is the first thing a user will notice if an application doesn't perform up to standards.

To put the difference in perspective, think of each task in 16-bit Windows as a single thread of execution. The program is executed in a linear fashion, from top to bottom, following the path represented by the thread. In 32-bit Windows, a process starts life as a single thread, but it can spawn additional threads to perform background tasks such as formatting a disk or recalculating a spreadsheet. Each thread is like a fork in the road describing a path for the CPU to follow, and each path is executed (and multitasked) independently, as if it were a separate program.

By splitting CPU time among concurrent threads, Windows 95 and OS/2 create the illusion that the threads run in parallel. On a machine with multiple CPUs, Windows NT really does run two or more threads at the same time by assigning different threads to different processors. This feature is known as *symmetric multiprocessing*, or SMP. PCs with two or more CPUs are novelties today, but in a few short years we'll all be running 4 to 16 processors in a box. And when we do, we'll all want SMP.

In Windows 95, as in Windows NT and OS/2, it is the thread, and not the process or task, that is the atomic unit of execution. If an application wants to do several things at once, it can simply dedicate a thread to each. The operating system then makes sure that each thread gets the CPU time it requires. A 16-bit application, by contrast, can carry out two operations at once only if it contains special—and

Single vs. Multiple Threads of Execution

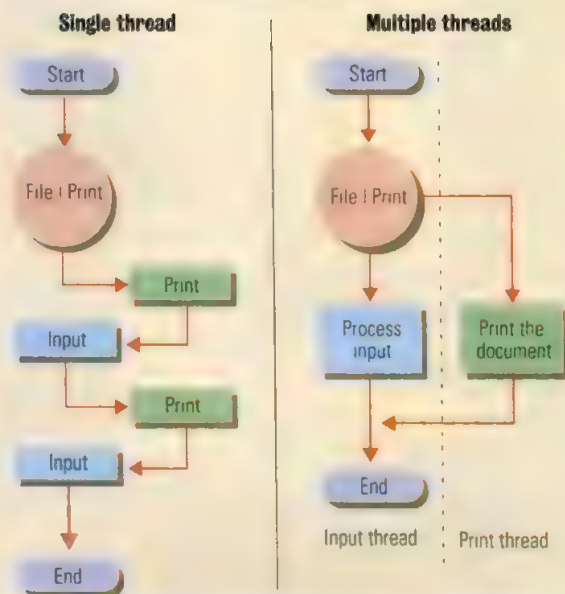


FIGURE 1: Confronted with the task of printing a document while remaining responsive to user input, a multithreaded application can delegate the printing process to a separate thread of execution. The input thread and print thread then run in parallel until printing is completed. A single-threaded application, by contrast, must alternate between printing and checking for user input, which slows down printing and decreases responsiveness.

usually very tricky—code to alternate between them. This usually means that each operation must be subdivided into smaller pieces that can be performed alternately. It also means that if one piece of one operation takes longer than it should to execute, the

that thread is running, the operating system switches rapidly between the input thread and the print thread so that both appear to be running at once. Moreover, each thread is utilized with maximum efficiency. While the input thread awaits input, the print thread receives the lion's share of the CPU. But as soon as the user presses a key or clicks a mouse button, the print thread is preempted and control is transferred back to the input thread. No time is wasted waiting for input, but when an input event occurs, the program responds immediately.

Ever notice how difficult it is to do meaningful work while the Windows 3.1 Print Manager prints a large document? Now you know why: Print Manager isn't able to do its printing in a separate thread. Instead, it has to print a few characters, yield, print a few more characters, yield, and keep repeating this process until printing is completed. Typed characters and other input wait in line for processing behind chunks of data transmitted to the printer. In Windows 95, Windows NT, and OS/2, however, background printing is demonstrably less intrusive, in part because print spooling is performed by a dedicated thread that is preempted by input events. This is clear evidence of the difference that multithreading can make.

THREAD SCHEDULING

For the operating system, deciding which thread to execute next and how long to let it run is a complicated process involving many factors. It's not just a matter of setting a timer to fire every few milliseconds and activating each thread in turn. Such a system would offer little improvement over the 16-bit systems we're used to today.

The primary consideration in scheduling threads for execution is each thread's *execution priority*. Windows 95 and Windows NT assign each thread a priority value from 0 to 31, with higher numbers indicating higher priority. Priority 31 is reserved for extremely critical tasks such as real-time data acquisition, while priority 0 is used by the operating system for certain idle-time tasks that are performed only when nothing else is going on. Most threads run at priority levels from 7 to 11. Every few milliseconds, the operating system's scheduler

evaluates all the threads in the system and allocates processor time to the one with the highest priority. If two or more threads have equally high priority, the one that has been executed least recently is executed next. In general, high-priority threads are always executed before low-priority threads, and threads with low priority never preempt threads with high priority.

Does this mean that if a priority-10 thread is executing in the system along with four priority-9 threads, the priority-9 threads will never execute? Not at all. Remember, in Windows everything is message-based. A Windows application doesn't process mouse and keyboard input directly; rather, it receives messages from the operating system informing it that a mouse or keyboard event has occurred. If the priority-10 thread empties its message queue—that is, if there is nothing more for it to do until another message comes along—it is suspended so that lower-priority threads can execute. A suspended thread receives no processor time until something wakes it up. When the sleeping priority-10 thread receives a message, it will wake up and preempt a priority-9 thread that is currently executing. Until then, it consumes zero processor time. Most threads spend a lot of time in a suspended state waiting for input events, so in all but the most extreme cases even priority-0 threads get ample time to execute. Nonetheless, a poorly written application can still bring the rest of the system to a crawl. Fortunately, poor threading design is very obvious in testing, and most software makers iron out the performance problems before shipping.

Windows 95 plays a lot of tricks with priority levels to make applications as responsive

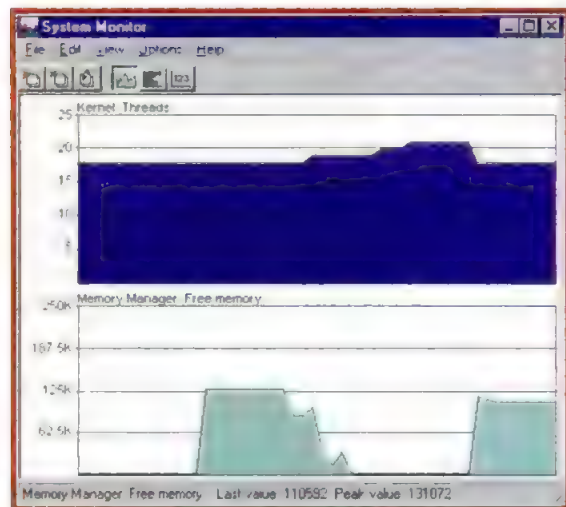


FIGURE 2: The System Monitor supplied with Windows 95 displays thread counts as well as other interesting statistics about the system.

other half of the program loses out on needed processor time. If the half that gets short-changed is the one that reads and processes input from the user, the application will suddenly seem sluggish and unresponsive.

The diagram in Figure 1 illustrates the difference between single and multiple threads of execution in two hypothetical word processing programs. At one point in each program, the user selects Print from the File menu and the application begins sending the document to the printer. Printing is done in the background, so the user can continue typing.

First, consider the single-threaded application on the left. When printing is begun, the application begins alternately checking for input and sending data to the printer. The program logic is complicated because the printing process must be broken into steps and performed one step at a time. Worse, the application's responsiveness suffers, because mouse and keyboard events are accorded no priority over the printing process. If the user presses a key right after the application begins printing a block of data, the event languishes in an input queue until the application turns its attention away from the printer. Input latencies can be reduced by breaking the printing process into smaller pieces requiring less time to execute, but that, too, has its drawbacks: More time devoted to checking for input means more time needed for printing.

In the multithreaded application, background printing is no big deal; the program starts a second thread, whose sole purpose is to output the document to the printer. While

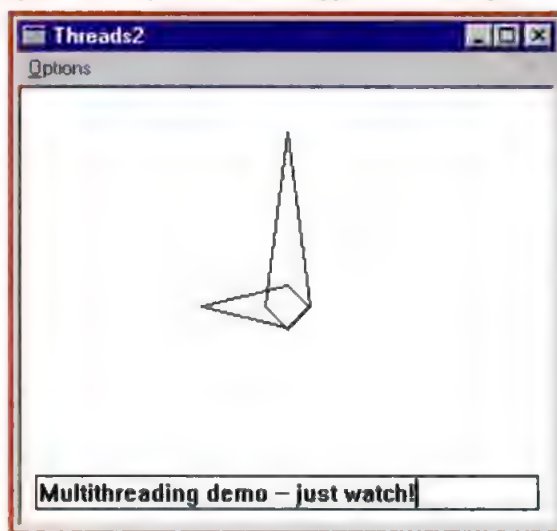


FIGURE 3: Threads2 uses three threads of execution: one to process user input, a second to spin the hands of the clock continuously, and a third to walk the directory structure of your hard disk counting files and directories—all at the same time.

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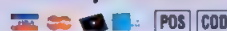
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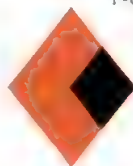
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as possible. For instance, Windows 95 automatically boosts the priorities of the active application's threads by 1 so it will receive priority over applications running in the background. This makes the foreground application quicker to respond to user input. In addition, the scheduler temporarily boosts the priority level of a thread that receives an input message by 1 or 2 so the processing of that message will receive priority over just about everything else. The thread is then gradually reduced to its normal priority level so it won't consume processor resources needlessly.

USES FOR MULTIPLE THREADS

Just how are multiple threads used in today's applications? Knowing exactly what an application is doing with its threads is difficult when you don't have access to its source code, but finding out how many threads an application uses is easy enough. One of the components that comes with Windows 95 is the System Monitor, found in the Start | Programs | Accessories | System Tools menu. (If you did not install it the first time around, click Start | Settings | Control Panel and open the Add/Remove Programs icon.) One of the items of information that System Monitor will display for you is the number of threads running in the system, as shown in Figure 2. By starting an application with System Monitor running and watching the thread count, you can determine how many threads the application uses. If the application uses a dedicated thread for background printing, you'll probably see the thread count bump up by 1 when you print a document.

You'll discover that Windows 95 uses several threads itself, because even with no applications other than System Monitor running, you'll never see the thread count drop below 12 or 13. Windows 95 uses one thread for nothing but fault handling, which makes it easier for the operating system to recover when an application suffers a general protection fault or causes other severe errors. It also runs animated cursors in a dedicated thread that is assigned a high priority but spends most of its time suspended, waiting for the moment to draw the next "frame."

The Windows 95 shell also takes advantage of the operating system's multithreading capabilities. For example, each window that you open in the shell is managed by a separate thread. If you drag-copy a file from one window to another, the thread associated with the window on the receiving end of the exchange performs the copy operation. The Taskbar is assigned its own thread, as is the window that represents the desktop. Shell-extension DLLs are run in separate threads so that if a shell extension goes down, it won't take the shell with it. The shell even uses one thread to gather file-change notifications and lump them together. This way a window doesn't get bombarded with

notifications if someone opens a DOS window and copies 100 files to a folder whose contents are visible in an Explorer window.

Windows NT finds still other uses for threads. For example, Windows NT uses a priority-0 thread to zero the contents of unused memory pages. It also uses a dedicated raw-input thread to capture mouse and keyboard events, convert them into messages, and distribute the messages to the various message queues.

HANDS ON: SINGLE VS. MULTIPLE THREADS

Of course, theory can only take you so far. Ultimately, it's instructive to see a hands-on demonstration of the difference that multi-

Knowing exactly what
an application is doing
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uses is easy.

threading can make. For this reason, I've written a pair of Windows 95 programs named *Threads1* and *Threads2* that you can download from PC Magazine Online. Both programs do exactly the same thing, but *Threads1* uses one thread of execution to get the job done, while *Threads2* uses up to three. The difference between the two programs is hardly earthshaking (*Threads1* uses plenty of tricks to make it *seem* like there's more than one thread running), but it is illustrative nonetheless.

For starters, open *Threads2* (shown in Figure 3) and select Start Clock from the Options menu. This launches a second thread that spins the clock hands continuously. Now decrease the window size, tuck it away in one corner of the screen, and start an application such as Excel or Word. Notice that the clock hands spin just about as fast when *Threads2* is running in the background as when it's running in the foreground. Also notice that typing a character in Word or Excel momentarily slows the spinning hands. That's a result of the dynamic priority boosting that the system does in response to input messages. Word or Excel's input thread gets a temporary boost when a key is pressed, which takes a few CPU cycles away from the thread that spins the hands. After 2 or 3 seconds, the input thread resumes its normal priority and the hands speed up again.

Now, with the clock still running, select Start Disk Check from the Options menu. This

starts a third thread that examines every directory on the C: drive and, when it's finished, displays a count of files and directories. The check usually takes several seconds, and during that time the hands slow to roughly half their normal speed. The CPU can't do two things at once, so when it executes two threads of equal priority and neither thread is a user-interface thread (meaning neither thread checks the message queue and therefore can't become suspended while waiting for user input), each thread performs at about half its normal pace. But even with two relatively time-consuming background operations going on, *Threads2* continues to respond ably to user input. Menus pop up quickly, and there is no perceptible delay when you type characters in the edit control at the bottom of the window.

Threads1 attempts to do the same thing with only one thread. But notice that when you pull down a menu, the hands stop. They also stop when a message box is displayed, and they remain frozen for the entire time that a disk check is in progress. Some clever coding could partially mitigate these deficiencies, but take my word for it that *Threads1* already has its share of clever coding just to make the hands spin and the disk check work without severely compromising responsiveness. The edit control at the bottom of the window works pretty well, but there is a small amount of jerkiness evident when typing while a disk check is performed.

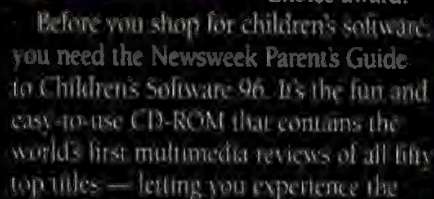
There are other experiments you can try, too. For example, line up four copies of *Threads2* in a row and watch the hands as you switch among applications. The speed of the hands is roughly indicative of the number of time slices each thread is getting, because the clock thread tries to move the hands as quickly as it can. Repeat the experiment with *Threads1* and you'll find that multitasking is noticeably less smooth, as evidenced by the more irregular movement of the hands.

FURTHER READING

If you'd like to learn more about threads and explore some of the technical issues in more detail, let me recommend two books. The first is *Advanced Windows*, by Jeffrey Richter (1995, Microsoft Press). In addition to providing all the information a programmer needs to write multithreaded applications, this book includes riches of information regarding the Windows NT and Windows 95 schedulers and the nature of threads themselves. A second source of information is Adrian King's *Inside Windows 95*, also from Microsoft Press. In this book, King overviews the system architecture as it relates to processes and threads and briefly describes some aspects of scheduling and the operating system's internal use of threads. □

Jeff Prosise is a contributing editor of PC Magazine.

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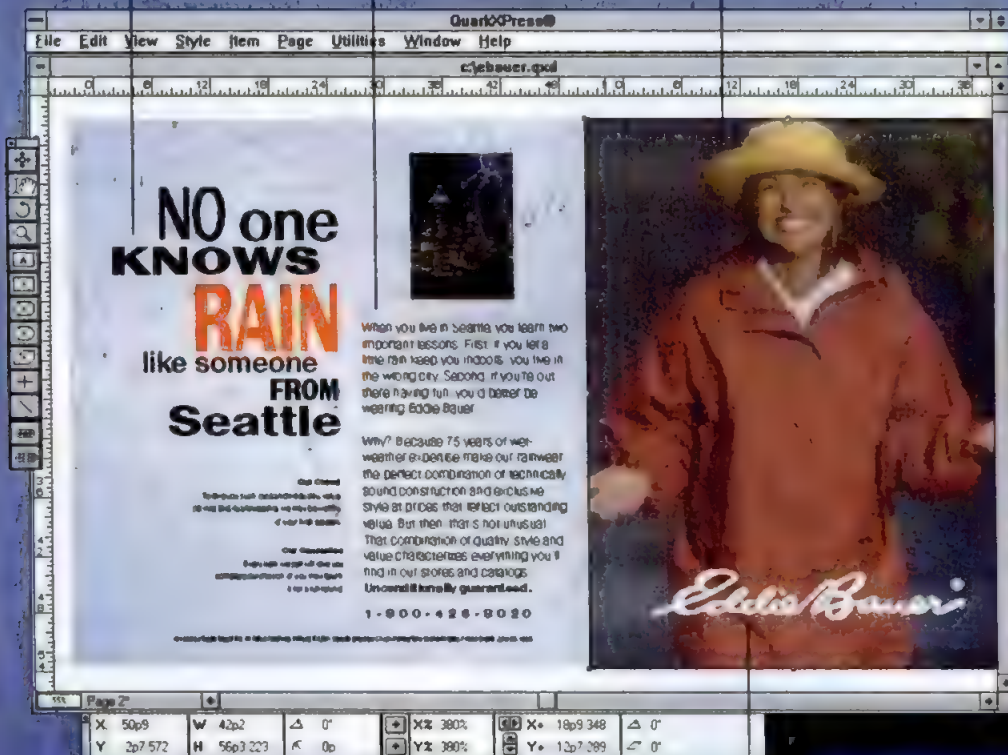
In QuarkXPress is unmatched. QuarkXPress can adjust the spaces between words and letters to within 1/2000 of an em space. You have the same precision when dealing with line spacing (leading), paragraph spacing, hyphenation, justification, indents, hanging indents, and special line breaks.

can be applied to any font. The word "KNOWS" has been set in the same font as the word "RAIN." However, "KNOWS" has been horizontally stretched to 135% of its original length, and "RAIN" has been compressed to 60% of its original length.

can be easily manipulated in QuarkXPress. The raincoat TIFF shown here was scaled to 380% of its original size by quickly typing horizontal and vertical values in a palette. The same level of control exists for contrast, color, rotation, skew, and flipping (mirroring) of images.

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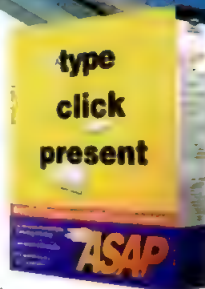
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PC Tech/Power Programming

By Ray Duncan

Publishing HTML Forms on the Web

Retrieving data separates the experts from the novices of HTML coding.

The first version of Hypertext Markup Language (HTML) was designed just for publishing scientific manuscripts electronically. If HTML hadn't been developed any further, that's about all the World-Wide Web ever would have been good for. Luckily for us, the wizards of HTML and the World-Wide Web did not rest on their laurels, and HTML has continued to develop at a brisk pace.

The addition of support for forms in HTML 2.0 made it possible to create interactive Web-based applications—to display a Web page to a user, collect some information from that user, and then take appropriate action based on that information. This in turn opened the door to the use of Web browsers as cross-platform front ends for polls and surveys, marketing, order entry, database searches, and a host of other client-server applications.

If you're trying to establish yourself as the Web guru at your company, thinking of doing a little free-lance Web consulting, or just putting together some killer Web applications for your own entertainment, acquiring a thorough grounding in HTML forms, scripts, and the Common Gateway Interface (CGI) needs to be high on your list of priorities.

Any idiot can go to the corner computer store, buy a copy of *HTML for Dummies*, mark up some existing documents with HTML tags, dump the results onto a Web server, and declare himself to be a World-Wide Web expert—and thousands have! But the ability to design and implement an attractive, interactive, forms-based Web application requires considerably more experience and understanding, not to mention a modicum of programming skills. This is definitely one of the easiest ways to separate the men from

the boys (or the women from the girls, as the case may be) when one is trying to filter the riffraff from the floods of would-be Web gurus and consultants.

This is a relatively complex topic, so we're going to have to spread the discussion of forms, scripts, and the CGI across several installments of *Power Programming*. In this column, we'll look briefly at the HTML 2.0 tags that support the creation of forms. In the second part of this series, we'll create a simple interactive application, using PERL scripts and the Microsoft Windows NT-based EMWAC HTTPS version 0.96 Web server as the processing engine. In the final installment, we'll talk in more detail about CGI, PERL, SQL gateways, and some other exotic topics.

FORMS AND DIALOGS

If you've already paid your dues in Windows, OS/2 Presentation Manager, or Macintosh programming, learning the basics of HTML form tags will be straightforward. In those three graphical environments, structured information is typically collected from the user by means of dialog boxes—pop-up windows whose size, location, and appearance is completely under the control of the programmer. A dialog box contains anywhere from one to many visual gadgets, called *controls*, with which the user can interact in a highly constrained manner.

Over time, a Darwinian process of natural selection has resulted in a small number of control types that look and behave pretty much the same on all three platforms: push buttons, radio buttons, check boxes, list boxes, multiline edit controls, and a few more. HTML supports most of these at some level.

So what's the catch? (You know there's got to be one!) The catch is that now you're building a cross-platform client-server application in which all of the screen interactions rely on a rather simple document-description language, whereas before you were writing a single-user application that would run in a known environment and have full access to the operating system's API. As a result you must live with several unfamiliar and disconcerting limitations:

- The capabilities of the user's system, ranging from the screen size to the number of available fonts and colors, cannot be known in advance and cannot be determined from the server side in any standardized way. Similarly, the rendering of form elements may vary greatly from one Web browser to another. Design and tuning of an HTML form so that it looks good and functions well

The screenshot shows a Netscape Navigator 1.1N window. The address bar contains the file path: file:///Q:/PROG/WWW/PP/1420/Figure1.htm. The page content includes a title bar, a menu bar (File, Edit, View, Go, Bookmarks, Options, Directory), and a toolbar with buttons for Back, Home, Reload, Open, Print, and Find. The main content area has the following sections:

- Single-Line Text Entry Boxes**: Two input fields. The first is labeled "Enter your last name" and contains the text "Doe". The second is labeled "Enter your first name" and contains the text "John".
- Multiple-Line Text Entry Boxes**: A large text area for input. Below it is a label "Enter your full address".
- Submit and Reset Buttons**: Two buttons, "Send My Data" and "Start Over".
- At the bottom, there is a footer: "Created 9/11/95 / Last modified 9/11/95", "PC Magazine / Power Programming / duncan@csmc.edu", and a small logo.

FIGURE 1: This is how the HTML document shown in Figure 2 appears in the Netscape Navigator 1.1N Web browser.



```
<HTML>
<HEAD>
<TITLE>HTML Form Example #1</TITLE>
</HEAD>
<BODY>

<FORM>

<H1>Single-Line Text Entry Boxes</H1>

Enter your last name:
<INPUT TYPE="text" NAME="lastname" SIZE="40"
MAXLENGTH="80" VALUE="Doe">

<P>

Enter your first name:
<INPUT TYPE="text" NAME="firstname" SIZE="40"
MAXLENGTH="80" VALUE="John">

<H1>Multiple-Line Text Entry Boxes</H1>
```

```
Enter your full address:
<TEXTAREA COLS="40" ROWS="8" NAME="address">
</TEXTAREA>

<H1>Submit and Reset Buttons</H1>

<INPUT TYPE="submit" VALUE="Send My Data">
<INPUT TYPE="reset" VALUE="Start Over">

</FORM>

<HR>

<ADDRESS>
Created 9/11/95 / Last modified 9/11/95<BR>
PC Magazine / Power Programming /
<A HREF="mailto:duncan@csmc.edu">duncan@csmc.edu</A>
</ADDRESS>

</BODY>
</HTML>
```

FIGURE 2: A simple HTML form demonstrating single-line and multiple-line text-entry boxes along with Submit/Reset push buttons.

in all client environments thus devolves to a process of laborious experimentation and testing, testing, testing.

- The information collected on a form is typically all shipped to the server at once when the user clicks a "submit" button. HTML does not support server-side monitoring of the user's manipulation of individual controls within a form or server-side enabling/disabling of individual controls on a form after the form has been shipped to the client browser.

- Unlike the resource script commands that define traditional dialog box controls, the HTML tags for controls do not include any positioning information. The controls are streamed into the Web browser's window in the order that they appear in the HTML source document. Furthermore, sophisticated visually oriented development tools comparable, for example, to Borland's Resource Workshop do not yet exist for on-screen design of HTML forms, at least on personal computers.

Obviously, there are workarounds for some of these problems. For example, you can influence the vertical spacing between controls with `<BR>` (line break) and `<P>` (paragraph) tags, and you can group controls together visually by means of `<HR>` (horizontal rule) tags or in-line graphics. You can ship alternative versions of a form to the Web client according to what you know about the user's previous choices. You can use HTML 3.0 tables to gain more precise control over the location of controls (for example, to align text labels and controls neatly in vertical columns), although this brings with it other complications. In general, however, your ability to build an HTML form that efficiently uses the

screen's real estate and adjusts itself to the users' needs as they interact with various controls on the form is still severely limited in the current incarnations of HTML.

HTML FORM BASICS

Five tags define all the interactive elements of an HTML form: `<FORM>`, `<INPUT>`, `<TEXTAREA>`, `<SELECT>`, and `<OPTION>`. These few tags, together with the tag modifiers known as *attributes*, suffice to code all the possible controls and designate which program or script will handle the form's data on the server side.

The fundamental tag of the group is `<FORM>`, which occurs as the tag pair `<FORM>` and `</FORM>` and which must appear within the `<BODY>` section of an HTML document. Any standard HTML-encoded text, headings, lists, and tables can occur between `<FORM>` and `</FORM>`, and all other form-related tags *must* be located between `<FORM>` and `</FORM>`. Thus, the skeleton of an HTML document that will be used as an interactive form looks something like this:

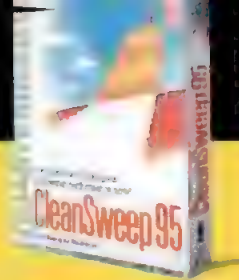
```
<HTML>
<HEAD>
<TITLE>Title Text</TITLE>
</HEAD>
<BODY>
<H1>Heading Text</H1>
<FORM>
.
. HTML text and
. controls go here
.
</FORM>
</BODY>
</HTML>
```

It's possible for a single HTML document to contain several distinct forms, each of which submits data independently to the server. This is accomplished by placing successive pairs of `<FORM>` ... `</FORM>` tags within the `<BODY>` of the same document. This practice can be quite confusing to the user, however, and I recommend that you avoid it.

The `<FORM>` tag has three possible attributes or modifiers: `ACTION`, `METHOD`, and `ENCTYPE`. The `ACTION` attribute's value is the URL of a program or script on the Web server that will be used to process the data collected by the form. The `METHOD` attribute takes on the value `GET` or `POST`, which defines how the data will be passed to the processing program on the server. We'll discuss what this means in the next column. The `ENCTYPE` attribute has been reserved for encrypted transactions and will not concern us further here.

The next most important tag is `<INPUT>`, which is a multipurpose tag for creating push buttons, radio buttons, check boxes, and single-line text-entry boxes. The `<INPUT>` tag has eight possible attributes: `ALIGN`, `CHECKED`, `MAXLENGTH`, `NAME`, `SIZE`, `SRC`, `TYPE`, and `VALUE`. But don't worry, some of these eight attributes are rarely needed! The crucial attributes are `NAME`, which associates a unique programmer-defined symbol with the control (to identify data entered into that control when it is returned to the server), and `TYPE`, which can take on the values `TEXT`, `PASSWORD`, `CHECKBOX`, `RADIO`, `SUBMIT`, `RESET`, `IMAGE`, and `HIDDEN`. The `VALUE` attribute allows the programmer to define a default value for the control.

The `<TEXTAREA>` tag must be used as a tag pair, `<TEXTAREA>` and `</TEXTAREA>`.



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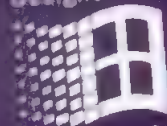
* See, e.g., *United States v. Microsoft Corp.*, 896 F.2d 1545, 1550 (9th Cir. 1990) (“Microsoft is the only company in the world that has developed a software program that is so widely used that it has become a standard.”); *United States v. Microsoft Corp.*, 896 F.2d 1545, 1550 (9th Cir. 1990) (“Microsoft is the only company in the world that has developed a software program that is so widely used that it has become a standard.”).



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```

<HTML>
<HEAD>
<TITLE>HTML Form Example #2</TITLE>
</HEAD>
<BODY>

<FORM>

<H1>Radio Buttons</H1>

Are you married?<BR>
<INPUT TYPE="radio" VALUE="Yes" NAME="married">
Yes Indeed!<BR>
<INPUT TYPE="radio" VALUE="No" NAME="married" CHECKED>
No Way<BR>
<INPUT TYPE="radio" VALUE="Maybe" NAME="married">
I'm Not Too Sure<BR>

<H1>Checkboxes</H1>

What types of books do you like to read?<BR>
<INPUT TYPE="checkbox" NAME="history" CHECKED>History<BR>
<INPUT TYPE="checkbox" NAME="biography">Biography<BR>
<INPUT TYPE="checkbox" NAME="scifi">Science Fiction<BR>
<INPUT TYPE="checkbox" NAME="other">Other<BR>

<H1>Pop-Up and Scrolling (Listbox) Menus</H1>

Select a color for your new car:
<SELECT NAME="carcolor">
<OPTION SELECTED>Red
<OPTION>Green
<OPTION>Blue
<OPTION>White
<OPTION>Black
</SELECT>

<H1>Submit and Reset Buttons</H1>

<INPUT TYPE="submit" VALUE="Send My Data">
<INPUT TYPE="reset" VALUE="Start Over">

</FORM>

<HR>

<ADDRESS>
Created 9/11/95 / Last modified 9/11/95<BR>
PC Magazine / Power Programming /
<A HREF="mailto:duncan@csmc.edu">duncan@csmc.edu</A>
</ADDRESS>

</BODY>
</HTML>

```

FIGURE 3: A simple HTML form demonstrating radio buttons, check boxes, and a five-item menu displayed both as a pop-up pick list and as a list box. It also shows submit and start-over push buttons.

The pair creates a multiline text-entry box and optionally delimits the default text to appear within the box. The <SELECT> tag is also employed as a tag pair, <SELECT> and </SELECT>, and it is used to build menus, or pick lists. <OPTION> tags supply the text for the individual elements of <SELECT> menus.

Now that we've been exposed to the basic building blocks of HTML forms, we'll review each form tag in more detail from a functional perspective.

TEXT BOXES

First, let's examine HTML support for free-text entry by the user. In Windows dialog boxes, text entry boxes are called *edit* controls, and they have the magic window class-name EDIT. From the user's point of view, there appear to be two types of edit controls in Windows: a single-line text-entry box and a multiline text-entry box whose scroll bars automatically turn on and off depending on the amount of text present. From the programmer's point of view, however, the only real difference is the presence or absence of the window style bit ES_MULTILINE. In HTML, the coding scheme follows the user's

perspective: Different tags define single-line and multiline text-entry boxes.

A single-line text-entry box is created by an <INPUT> tag with attribute TYPE set to TEXT. The NAME attribute is used to assign a unique symbol to the control and the VALUE attribute will put some default text into the box. You can use the SIZE and MAXLENGTH attributes to specify the visual width of the box in characters and the maximum number of characters that can be entered into the box, respectively. Any user-oriented label for the text-entry box occurs outside the <INPUT> tag, using ordinary HTML text coding procedures.

For example, let's say you want to create a text-entry box 40 characters wide for entry of a string with no more than 80 characters, assign the symbol lastname to the data collected in the box, fill in the text box with the default value Smith, and cue the user with an "Enter last name:" label. You would use the following HTML code:

```

<P>
Enter last name:
<INPUT TYPE="text" NAME="lastname"

```

```

VALUE="Smith" SIZE="40"
MAXLENGTH="80">
<P>

```

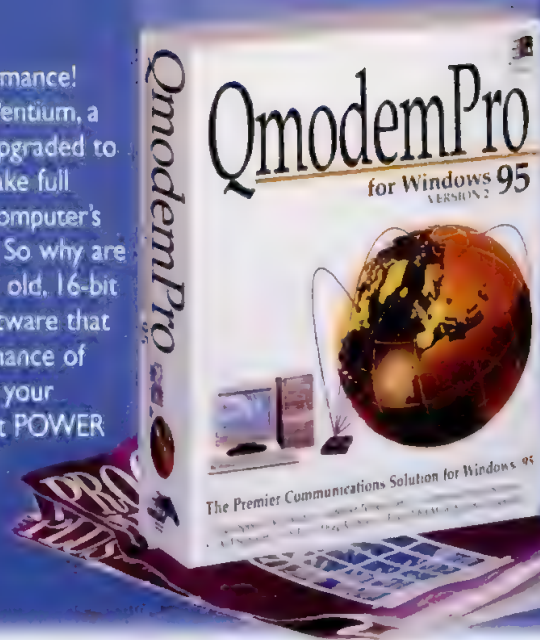
Multiline text-entry boxes are created with the tag pair <TEXTAREA> and </TEXTAREA>. The multiline text boxes have automatic scroll bars and support simple text-editing functionality (backspace, copy, cut, paste, and so on), much like a multiline edit control in a Windows dialog box. The <TEXTAREA> tag has the attributes ROWS and COLS, which define the visual dimensions of the text-entry area in terms of the number of rows and number of columns, and the attribute NAME, which specifies the symbol assigned to the data collected in the box for server processing. Any default text you want to place in the multiline text box should be located between the <TEXTAREA> and </TEXTAREA> tags.

For instance, to create a multiline text-entry box that is 40 columns wide and 8 rows high, assign the symbol address to the data entered in the text box, provide no default text in the box, and cue the user with an "Enter your full address:" label, you would write the following HTML code:

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Rock beats scissors.
Scissors beats paper.
32-bit beats 16-bit.**

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<P>

Enter your full address:

<TEXTAREA COLS="40" ROWS="8"

NAME="address">

</TEXTAREA>

<P>

RADIO BUTTONS AND CHECK BOXES

From the user's perspective, HTML radio-button groups work the same way as their Windows cousins; each button in a group can have any label you like, and only one button can be selected at a time. From the programmer's perspective, HTML radio buttons are simpler than Windows radio buttons in some respects and messier in others.

When one radio button in an HTML radio-button group is clicked, that button is turned on and the others are turned off automatically—that is, the Web browser handles the entire mutual-exclusion aspect of radio buttons. In Windows, on the other hand, the programmer must know which buttons are grouped, detect when any radio button of a group has been clicked with the appropriate message processing, and explicitly turn each button in the group on and off as necessary.

Visual positioning of the radio buttons in an HTML radio-button group, however, is an iffy proposition. In Windows the programmer can specify quite exactly the position of the radio buttons in the dialog box and how they will be oriented with respect to one another. But the HTML author must either use
 (line break) or <P> (paragraph) tags to force the radio buttons into a vertical row (wasting all the window space to the right of the radio-button group) or allow the radio buttons to stream out horizontally and hope the Web browser's window will be wide enough to hold the entire group on a single line.

HTML radio buttons are created with the <INPUT> tag, using a TYPE attribute of RADIO. The data returned to the server by each radio button is defined by its VALUE attribute. Radio buttons are grouped together logically by giving them all the same NAME attribute (which also specifies the symbol with which the data from the radio-button group will be associated when the form's contents are sent to the server). Within a logical group, the radio button that is to be selected by default receives the

CHECKED attribute.

For example, let's say you want to create a group of three vertically aligned radio buttons with the labels Yes, No, and Maybe; assign the symbol "married" to the group; select No as the default button; and cue the user with an "Are you married?" label. You would write the following HTML code:

```
Are you married? <BR>
<INPUT TYPE="radio" VALUE="Yes"
NAME="married">Yes<BR>
<INPUT TYPE="radio" VALUE="No"
NAME="married" CHECKED>No<BR>
<INPUT TYPE="radio" VALUE="Maybe"
NAME="married">Maybe<BR>
```

HTML check boxes are coded much like radio buttons, with the exception (just as in Windows) that grouping of check boxes is only visual, not logical: More than one check box of a group can be selected at a time. You create a check box with the <INPUT> tag, using a TYPE attribute of CHECKBOX, and each check box is assigned a unique symbol for server processing with the NAME attribute. The CHECKED attribute controls the default state of each check box.

Let's design a group of four vertically aligned check boxes with the labels History, Biography, Science Fiction, and Other; turn

on the History check box by default; and cue the user with the text "What types of books do you like to read?" The following HTML code should do the trick:

```
What types of books do you like to
read? <BR>
<INPUT TYPE="checkbox" NAME="history"
CHECKED>History<BR>
<INPUT TYPE="checkbox" NAME=
"biography">
Biography<BR>
<INPUT TYPE="checkbox" NAME="scifi">
Science Fiction<BR>
<INPUT TYPE="checkbox" NAME="other">
Other<BR>
```

MENUS AND LISTS

In HTML forms, pop-up menus or "pick lists" (which are comparable to Windows combo box controls) and scrolling menus (which are comparable to Windows list box controls) are both coded with the <SELECT> ... </SELECT> tag pair.

The <SELECT> tag has the required attribute NAME, which specifies the symbol associated with the control for server processing, and the optional attributes SIZE and MULTIPLE. If the SIZE attribute is missing, only the currently selected item is visible until the menu is clicked with the mouse, at which

point the entire list of menu items appears in a pop-up window. If the SIZE attribute is present, it defines the number of menu items that are visible simultaneously, and you get a scrollable list box. The MULTIPLE attribute is for creating menus that allow for simultaneous selection of multiple items, but such menus are rarely used because of the difficulty in processing the data returned by these menus at the server end.

The <OPTION> tags indicate individual items within a menu defined by a <SELECT> ... </SELECT> tag pair. The optional SELECTED attribute on an <OPTION> tag is used to indicate which menu item is the default result for that menu.

As an example, here is the HTML code for a pop-up menu containing five different color choices as the menu items, with Red as the default choice, and assigned the symbol car-color for purposes of server processing. The user is cued with the text "Select a color for your new car."

FIGURE 4: The HTML document from Figure 3 as it appears in the Netscape Navigator 1.1N Web browser.

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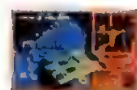
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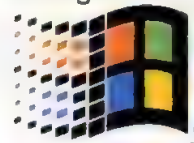
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<P>

Select a color for your new car:

<SELECT NAME="carcolor">

<OPTION SELECTED>Red

<OPTION>Green

<OPTION>Blue

<OPTION>White

<OPTION>Black

</SELECT>

<P>

To display the same menu as a list box, with all five choices visible at once, we'd just change the <SELECT> tag as follows:

< SELECT NAME="carcolor" SIZE="5">

PUSH BUTTONS

In Windows dialog boxes, push buttons can be nearly any size, can be individually enabled or disabled (grayed out), and can carry any text label. They automatically change appearance when clicked on, and they send a generic WM_COMMAND message to the parent program that can be linked to any action whatsoever. HTML push buttons are, by comparison, a bit brain-damaged. They can carry any text label you like, but they have only two possible actions: clearing the entire form (resetting all controls to their default values) or sending all the data collected in the form to the server.

HTML push buttons are coded with the <INPUT> tag, using the TYPE attribute SUBMIT or RESET depending on whether you want to submit the form's data to the server or clear the form. They employ the VALUE attribute to specify the label for the button. For example, to create a push button labeled "Search the Database" that will submit the data from the form to the server, you would use the following <INPUT> tag:

```
<INPUT TYPE="submit"
VALUE="Search the Database">
```

When the user clicks a push button of type SUBMIT, the contents of all the controls on the form are sent as a series of *CONTROL-NAME=CONTROLDATA* pairs to the program or script specified in the ACTION attribute of the enclosing <FORM> tag. The exact manner in which the data is presented to the program or script depends on the METHOD attribute of the <FORM> tag. If this all sounds a bit obscure, let it ride for now; we'll return to the subject of forms processing in the next column.

Figures 2 and 3 contain example HTML documents demonstrating the various form tags, and Figures 1 and 4 show how these documents appear in the Netscape Navigator, Version 1.1N browser.

ADDITIONAL RESOURCES

As I have said before, you can find the most up-to-date information on Web publishing

and HTML coding on the Web itself, using the World-Wide Web Consortium's home page at <http://www.w3.org> as a starting point. The good news is that all this information is free. The bad news is also that this information is free—in the sense that you get what you pay for.

There are many tutorials and gobs of well-meaning advice to be found on the Web, but essentially none of it has been subjected to the formalized checks and balances of technical reviews and manuscript editing, so the quality and organization of the material is quite erratic. Until commercial publishing on the Web becomes a reality, there is still a place for traditional printed books. Here are a few containing information on HTML forms and scripts that you may find helpful:

- *HTML for Fun and Profit*, by Mary E. S. Morris. Includes a CD-ROM with server software, sample HTML documents, and CGI scripts for Windows NT, Unix, and the Macintosh System. Upper Saddle River, NJ: Prentice Hall, 1995. 264 pages. \$35.95. ISBN: 0-13-359290-1.

- *Netscape and HTML Explorer*, by Urban A. LeJeune. Includes CD-ROM with various tools, editors, and sample forms and scripts for Windows. Scottsdale, AZ: Coriolis Group Books, 1995. 723 pages. \$39.99. ISBN: 1-883577-57-8.

- *Serving the Web*, by Robert Jon Mudry. Includes CD-ROM with Slackware distribution of Linux, PERL for DOS and Windows NT, HTML editors, graphics tools, clip art, and various TCP/IP stacks and clients (mainly for Windows). Scottsdale, AZ: Coriolis Group Books, 1995. 487 pages. \$39.99. ISBN 1-883577-30-6.

- *How to Set Up and Maintain a World Wide Web Site*, by Lincoln D. Stein. Reading, MA: Addison-Wesley, 1995. 469 pages. \$29.00. ISBN: 0-201-63389-2.

- *Build a Web Site*, by Net.Genesis and Devra Hall. Rocklin, CA: Prima Publishing, 1995. 715 pages. \$34.95. ISBN: 0-7615-0064-2.

The Morris, LeJeune, and Mudry books are midlevel HTML tutorials with some coverage of forms and simple scripting. The Stein and Net.Genesis books offer in-depth coverage of CGI and PERL scripts. The Net.Genesis book is the most technically sophisticated of the bunch and includes rather elaborate scripts and sample code for HTTP clients and servers along with the full HTTP and HTML specifications. □

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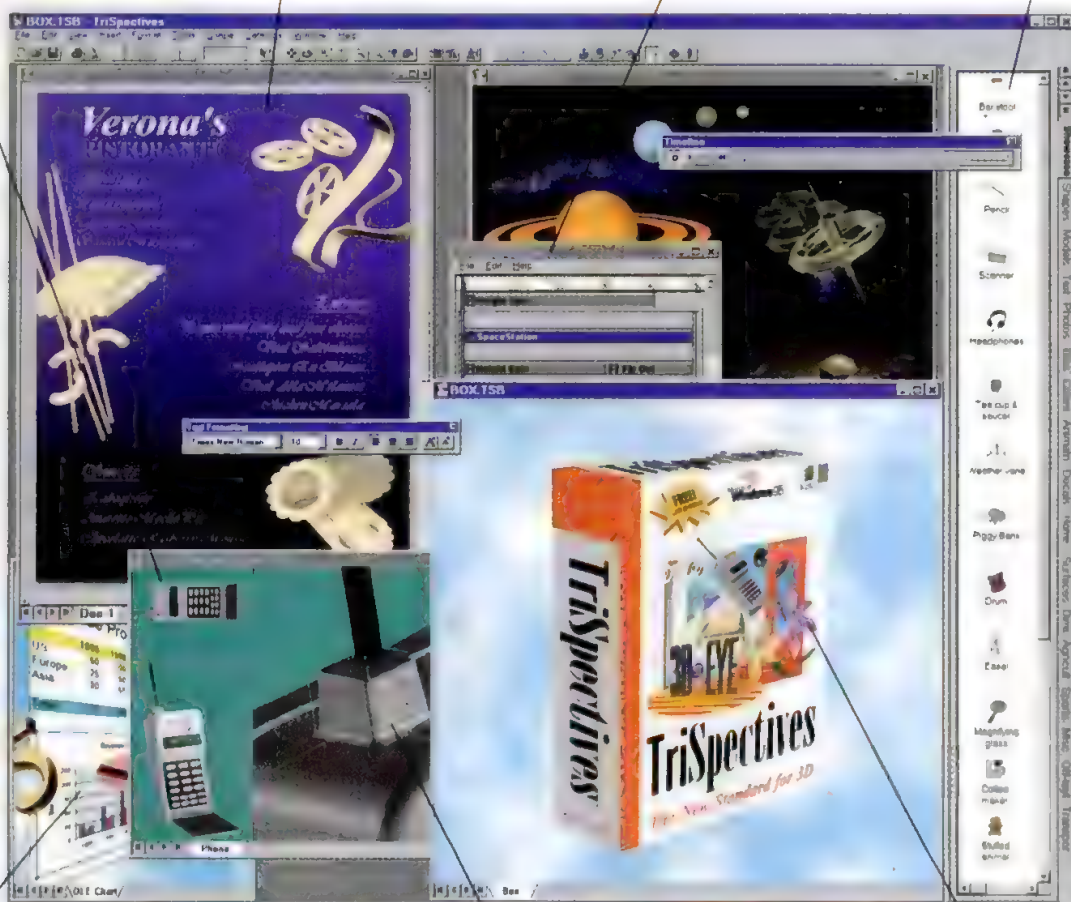
Stanford Dehl, BYTE Magazine, October 1995

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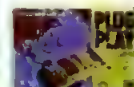
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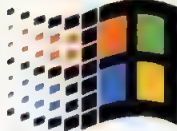
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```
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Select a color for your new car:
<SELECT NAME="carcolor">
<OPTION SELECTED>Red
<OPTION>Green
<OPTION>Blue
<OPTION>White
<OPTION>Black
</SELECT>
<P>
```

To display the same menu as a list box, with all five choices visible at once, we'd just change the `<SELECT>` tag as follows:

```
< SELECT NAME="carcolor" SIZE="5">
```

PUSH BUTTONS

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```
<INPUT TYPE="submit"
VALUE="Search the Database">
```

When the user clicks a push button of type SUBMIT, the contents of all the controls on the form are sent as a series of `CONTROL-NAME=CONTROL-VALUE` pairs to the program or script specified in the ACTION attribute of the enclosing `<FORM>` tag. The exact manner in which the data is presented to the program or script depends on the METHOD attribute of the `<FORM>` tag. If this all sounds a bit obscure, let it ride for now; we'll return to the subject of forms processing in the next column.

Figures 2 and 3 contain example HTML documents demonstrating the various form tags, and Figures 1 and 4 show how these documents appear in the Netscape Navigator, Version 1.1N browser.

ADDITIONAL RESOURCES

As I have said before, you can find the most up-to-date information on Web publishing

and HTML coding on the Web itself, using the World-Wide Web Consortium's home page at <http://www.w3.org> as a starting point. The good news is that all this information is free. The bad news is also that this information is free—in the sense that you get what you pay for.

There are many tutorials and gobs of well-meaning advice to be found on the Web, but essentially none of it has been subjected to the formalized checks and balances of technical reviews and manuscript editing, so the quality and organization of the material is quite erratic. Until commercial publishing on the Web becomes a reality, there is still a place for traditional printed books. Here are a few containing information on HTML forms and scripts that you may find helpful:

- *HTML for Fun and Profit*, by Mary E. S. Morris. Includes a CD-ROM with server software, sample HTML documents, and CGI scripts for Windows NT, Unix, and the Macintosh System. Upper Saddle River, NJ: Prentice Hall, 1995. 264 pages. \$35.95. ISBN: 0-13-359290-1.
- *Netscape and HTML Explorer*, by Urban A. LeJeune. Includes CD-ROM with various tools, editors, and sample forms and scripts for Windows. Scottsdale, AZ: Coriolis Group Books, 1995. 723 pages. \$39.99. ISBN: 1-883577-57-8.
- *Serving the Web*, by Robert Jon Mudry. Includes CD-ROM with Slackware distribution of Linux, PERL for DOS and Windows NT, HTML editors, graphics tools, clip art, and various TCP/IP stacks and clients (mainly for Windows). Scottsdale, AZ: Coriolis Group Books, 1995. 487 pages. \$39.99. ISBN 1-883577-30-6.
- *How to Set Up and Maintain a World Wide Web Site*, by Lincoln D. Stein. Reading, MA: Addison-Wesley, 1995. 469 pages. \$29.00. ISBN: 0-201-63389-2.
- *Build a Web Site*, by Net.Genesis and Devra Hall. Rocklin, CA: Prima Publishing, 1995. 715 pages. \$34.95. ISBN: 0-7615-0064-2.

The Morris, LeJeune, and Mudry books are midlevel HTML tutorials with some coverage of forms and simple scripting. The Stein and Net.Genesis books offer in-depth coverage of CGI and PERL scripts. The Net.Genesis book is the most technically sophisticated of the bunch and includes rather elaborate scripts and sample code for HTTP clients and servers along with the full HTTP and HTML specifications. □

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By Sean González

Choosing an E-Mail Protocol

SMTP, POP, X.400, and IMAP each offer unique functionality.

Although e-mail does not offer the novelty or the visual excitement of the World-Wide Web, it continues to be one of the main uses of computer networks—including the Internet. Because it is such an integral part of everyday computing, many users tend to take e-mail for granted. But when you consider the plethora of different machines, operating systems, client applications, and protocols that reside on a network, successful e-mail transfer is just short of a miracle.

There are several different protocols that you can use to transfer e-mail; they all speak the same language, but each has slightly different functionality. Four of these protocols—SMTP (Simple Mail Transfer Protocol), X.400, POP (Post Office Protocol), and IMAP (Internet Mail Access Protocol)—cover the gamut of e-mail exchange methods. To choose the correct protocol for your network, you must carefully examine your specific needs.

GETTING THE MESSAGE ACROSS

If you think of TCP/IP communications in terms of a post office, each application protocol has the equivalent of its own post office box. Since SMTP is assigned box number 25, for instance, your client must establish a connection to port 25 of a given host (*telnet://ip.host.name:25*) to initiate an SMTP dialog with that host. POP, Version 3 uses port 110, while IMAP uses port 143. X.400, which uses a port that is defined by a particular X.400 server's address, is negotiated between the client and the server at the time the connection is made.

Once a connection is established, the client and the server begin a dialog that adheres to a particular protocol. The following is a sample SMTP dialog:

```
telnet://remote.host.name:25
220 ip.host.name Server SMTP
helo my.host.name
250 remote.host.name-Pleased to meet
you.
mail from: sean@iacnet.com
250 Address Ok.
rcpt to: someone@remote.host.name
250 someone@remote.host.name Ok.
```

```
data
354 Enter mail, end with a single ".".
This is only a test message.
Please ignore.
250 Ok.
quit
221 Bye received. Goodbye.
```

For every command the client sends to the server, the server responds with a status message. Although status messages may be facetious, overly polite, or even sarcastic, users seldom see the set of protocol commands. E-mail communications languages are used transparently by either MTAs (Mail Transfer Agents) or MUAs (Mail User Agents). MTAs are responsible for transferring mail from machine to machine. Your company's mail serv-

Although the security problems of Unix Sendmail are not inherent to SMTP, SMTP is widely considered an insecure protocol by association. With the introduction of MIME (Multipurpose Internet Mail Extensions), which ensures the delivery of file attachments on TCP/IP networks, SMTP has become more reliable. It is also much simpler and less expensive than X.400.

X.400, on the other hand, is renowned for its security. It uses security mechanisms such as authentication and encryption, as well as secure data links (sometimes involving leased or dedicated phone lines), to guarantee delivery of untampered e-mail. Since not all hosts can understand X.400, however, its use is restricted to networks whose security needs justify the additional upgrade costs.

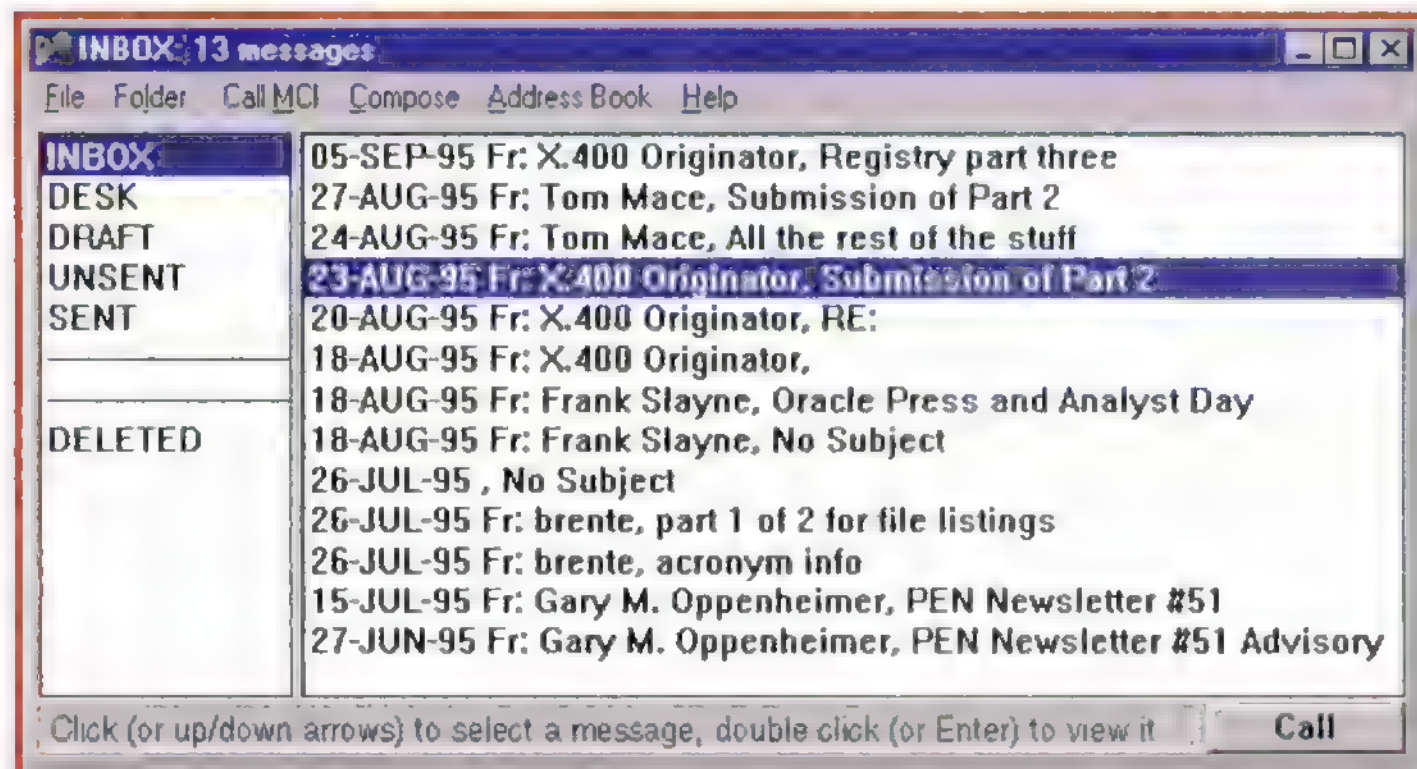


FIGURE 1: MCI Mail uses X.400 gateways to transfer messages to and from other e-mail systems.

er, for instance, most likely uses an SMTP-based MTA to send mail over the Internet. By comparison, MUAs are client software packages that allow users to interact with the e-mail system. The e-mail software on your PC is an example of an MUA.

SMTP AND X.400

SMTP and X.400 are used for mail transfer from host to host. SMTP is the most widely used e-mail exchange protocol on the Internet. One of its most popular implementations (Unix Sendmail), however, is also one of the Internet's most insecure applications.

POP AND IMAP

Although both POP and IMAP can be used to read e-mail on your PC, their capabilities and methods are extremely different. E-mail clients that use POP—the older of the two protocols—make periodic connections to the mail host to check for new mail. The client then downloads your new mail, which is usually deleted from the server. Thus, you can read your e-mail from your PC without an open network connection to the mail server. Some PC software packages allow you to specify when e-mail is to be deleted from the server. You can synchronize your

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e-mail client and the server, for instance, and remove messages from the server when you delete them from your client software.

E-mail clients that use IMAP let you remotely manipulate your mailbox on the mail host. You do not need to download e-mail to your PC or delete it from the server, because you maintain an open connection accessing your mailbox. IMAP clients also allow you to access e-mail stored on multiple hosts and in multiple folders on one host. If you frequently handle MIME documents, you will appreciate that IMAP lets you specify that attachments be downloaded only when you want to detach or launch

To choose the correct protocol for your network, you must carefully examine your specific needs.

them. POP clients, in contrast, download the message and all its attachments during the new-mail download phase.

POP clients are best suited for people who have only one mailbox on one mail host, handle small volumes of e-mail, and read e-mail from only one PC. If you use multiple mailboxes or multiple hosts, handle large volumes of e-mail, or need to read your mail from multiple locations (including different e-mail clients that are on different operating systems or machines), then you should use an IMAP client that keeps messages on the host. Unlike POP, IMAP can fetch documents other than e-mail (such as Usenet News) and can use a host's search capabilities to scan mail and News documents.

CHOOSING THE CORRECT PROTOCOL

When choosing the right e-mail client and server combination, you must consider myriad issues, including security, volume of messages you will handle, where your e-mail is stored, from where you will access your e-mail, and whether you will handle multipart (MIME) documents. Also, not all e-mail clients handle your messages efficiently. The wrong protocol can result in limited functionality and inefficient use of your mail host, network, PC resources, and time. □

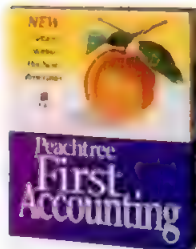
Sean González, a regular contributor to our *Internetworking* column, is a project leader for the *Internetworking Solutions* group at Information Access Center in Boston, Massachusetts.



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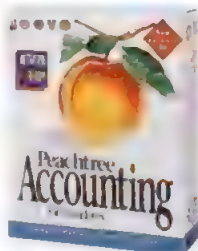
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CIRCLE 393 ON READER SERVICE CARD



PC Tech/Special Report

By Sheryl Canter

CD-Quick Cache: Smarter than SmartDrive

This year's Shareware Awards winner boosts your CD-ROM drive.

CD-ROM drives are a boon because of the enormous amounts of data they can store on one platter. But their downside is slow speed compared with that of hard disks. One way to cope with this drawback is to cache the CD-ROM. CD-Quick Cache, the overall winner of our 1995 Shareware Awards, is a CD-ROM cache for DOS and Windows 3.1 that outperforms Microsoft's SmartDrive. A Windows 95 version of CD-Quick Cache is in the works.

The idea behind any storage cache is to keep frequently used information in memory, where it can be accessed faster. The trick is figuring out what data the user will want to read next. When a CD-ROM is read sequentially, this is easy. SmartDrive, with its large read-ahead buffer, does a very good job of caching for sequential access.

But not all CD-ROM reads are sequential. Random access of information stored on a CD-ROM is quite common in many applications. It is in this area that CD-Quick Cache outsmarts SmartDrive, because CD-Quick includes logic to detect whether reads are sequential or random. If they are random, CD-Quick doesn't waste time filling the read-ahead buffer with data you're not going to read, so performance is improved.

EASY SETUP

CD-Quick's Install program copies the necessary files to your hard disk and places the cache command with the appropriate parameters in your AUTOEXEC.BAT file. If you are using SmartDrive, Version 5.0 (included with DOS 6.2), CD-ROM caching must be disabled with the /U switch. (Earlier versions of SmartDrive did not cache CD-ROM drives.) Also, CD-Quick must be loaded *before* MSCDEX, and the number of MSCDEX buffers should be reduced to six. The CD-Quick Install program takes care of all these details for you automatically.

In addition to the caching program itself, CD-Quick comes with two utilities: CDTest (see Figure 1), for testing your CD-ROM drive's performance before and after caching, and QuickMon (see Figure 2), for displaying cache statistics from within Windows. QuickMon displays the cache size, drive type, number of logical transfers, number of physical

transfers, number of physical transfers saved, and percent of physical transfers saved. You can also view cache statistics from the DOS prompt by typing CDQ.

CD-Quick works with all CD-ROM drives and can handle systems with multiple CD-ROM drives (up to 26, the DOS maximum for drive letters). It uses only 11K of conventional memory and can be loaded in high memory. When CD-Quick is loaded, the amount of buffer space needed by MSCDEX is reduced by about this same amount, so the net amount of memory used is negligible.

WHY CD-ROM DRIVES ARE SLOW

The optical technology employed by CD-ROM drives lets inexpensive plastic disks store vast amounts of data, but at the cost of slower access speeds. Most of today's hard disks have access times of 8 to 14 milliseconds. In contrast, a quad-speed CD-ROM drive takes a few hundred milliseconds to position itself for data access.

CDs store data on a single spiral track that winds from the inner edge of the disk to the outer rim. The track is a mere 0.6 microns (a millionth of a meter) wide. To get an idea of how small this is, consider that a human hair is about 100 microns in diameter. Not only is the CD track extremely narrow, the spiral is packed very tightly together—1.6 microns

apart. The track density is about 16,000 per inch. Data is packed so tightly that a CD—less than 5 inches wide—holds more than 3 miles of track. The positioning of the read head over such a narrow and densely packed data track must be extremely precise.

Laser technology, with its pinpoint precision, is needed to read data packed this densely. To complicate the problem further, CD-ROM drives must spin the disk at varying speeds to ensure that sectors cross the read head at a constant linear velocity. This is necessary because data sectors are the same length on every part of the CD. If the rotational speed were constant, the sectors at the outer edge would pass by the read head at almost three times the rate of those near the center.

The combined challenges of precisely positioning the read head and varying the rotational speed to ensure constant linear velocity make for CD access speeds that are 20 times slower than hard disk access speeds. Although triple- and quadruple-speed drives have increased the data transfer rate by increasing the rotational speed, access times—the time it takes to reposition a drive's read head—have not improved very much. Caching can help by minimizing the number of times the read head must be repositioned. Once data is read into the



FIGURE 1: CDTest—a utility that comes with CD-Quick Cache—lets you compare the performance of your CD-ROM drive before and after caching.

The Ziff-Davis 1995 Shareware Awards

The winners of this year's Shareware Awards were honored at a ceremony held on June 23, during the Shareware Industry Conference in Scottsdale, Arizona. Editors from Ziff-Davis Interactive, *PC Magazine*, *Computer Life*,

and *Computer Gaming World* evaluated more than 1,300 shareware programs that were introduced or upgraded in the last year. The 40 finalists are shown below by category, with the winners and runners-up indicated. CD-Quick was the

Best of the Year winner.

All the finalists are available on ZD Net in the Public Brand Software forum, Library 14 (GO PBSAPP). You can also read about the contest and download the programs by typing GO ZDAWARDS.

Program name	Download filename and size	Program name	Download filename and size
Business and finance		Networking	
Scheduling Employees for Windows	SEW.ZIP (884K) **	Inner-Net	INRNET.ZIP (62K) **
WinCharging	WINCRG.ZIP (1,184K) *	Watcher	WATCHE.ZIP (956K) *
Medlin Accounting	MEDLIN.ZIP (319K)	Network Security Organizer	NETSEO.ZIP (603K)
Medlin Windows Payroll	MWPR.ZIP (116K)	X-Forum3 Network Message Forum	XFORUM.ZIP (194K)
Universal Parcel Shipping Software	UPSS.ZIP (391K)	X-SKED3 Network Scheduling System	XSKED.ZIP (190K)
Communications		Programming tools	
SlipKnot	SLPKNT.ZIP (1,251K) **	Convi for Windows	CENVIW.ZIP (336K) **
WinRamp Lite	WRAMP.ZIP (1,338K) *	VB/Rig	VBRIG.ZIP (475K) *
FaxMail for Windows	FXMAIL.ZIP (666K)	Easy Install	EINSTL.ZIP (249K)
Telix for Windows	TELIXW.ZIP (2,477K)	Liberty BASIC for Windows	LBWIN.ZIP (861K)
Zap-O-Comm	ZOC.ZIP (566K)	Mabry Software Mega Pack	MSMEGA.ZIP (363K)
Major applications		Utilities—DOS	
SmartTracker Inventory	TKH.ZIP (393K) **	CD-Quick Cache	CDOCK.ZIP (172K) ***
Gator Edit	GATOR.ZIP (753K) *	Castle Oaks Utilities	COUTIL.ZIP (31K)
WordExpress	WXPRS.ZIP (1,151K) *	Design Shell	DESIGN.ZIP (921K)
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First Name Almanac for Windows	FNAWIN.ZIP (885K)	NOMSSI Viewer	NVIEW.ZIP (480K)
Math and science		Utilities—Windows	
Judy's TenKey	TENKEY.ZIP (188K) **	TextPad	TEXTPD.ZIP (681K) **
Conversion Master Engineering Calculator	CMSTR.ZIP (769K) *	clySmic Icon Bar	CLYSBR.ZIP (697K) *
WPlot	WPLLOT.ZIP (155K) *	File Finder for Windows	WFIND.ZIP (985K)
Mathplot	MATHPL.ZIP (122K)	WinZip Self-Extractor	WZIPSE.ZIP (111K)
PC-Track	PCTRA.ZIP (565K)	Win, What, Where	WWW.ZIP (2,008K)

* Runner-up. ** Winner. *** Best of the Year.

cache, it can be accessed from memory instead of from the CD—a vastly quicker operation.

HOW CACHING WORKS

A cache is an area in memory where frequently used data is stored for fast access. Data can be accessed from memory in microseconds—thousands of times faster than from a CD-ROM. This only helps, of course, when the data you need is in the cache. Figuring out what data to put in the cache is what the art of caching is all about. A technique common to all caching programs is to store everything read from the device in the cache. This works because most applications access data areas more than once; it is probable that data read once will be needed again in the future.

Another common technique for filling the cache is read-ahead buffer-

ing. With read-ahead buffering, the caching program reads one or more sectors beyond the data you requested. For sequential reads, read-ahead buffering is effective be-

cause the next sector (or sectors) of data is in the cache before you even request it. The probability that you'll eventually want this data is high if you're reading from the disk sequentially, but quite low if you're reading randomly.

CD-Quick uses a hash table to locate cached data quickly and to determine when requested data is not in the cache. If the requested data is not in the cache and the cache is full, some of the cached data must be discarded to make way for the new data. CD-Quick uses a least-recently-used algorithm to decide which data in the cache to overwrite; data you haven't accessed in a while is overwritten first.

CD-QUICK VERSUS SMARTDRIVE

SmartDrive, Version 5.0 uses a single cache for everything—hard disks, floppy disks, and CD-ROMs. This has disadvantages and is in fact no longer true under Windows 95. If you read a large enough block of data from any of

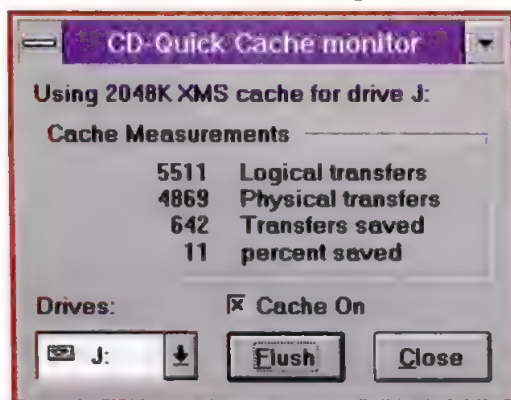
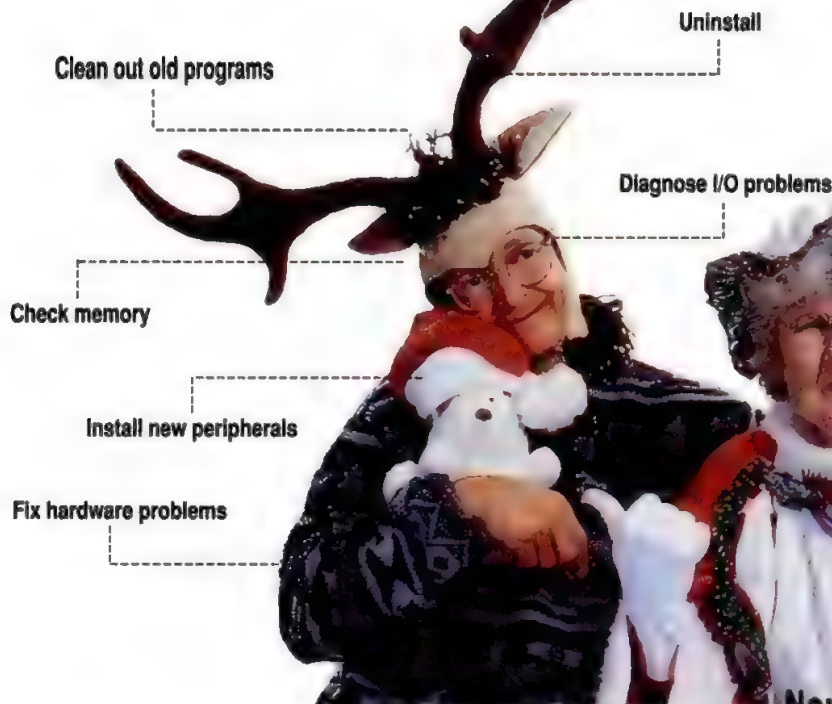


FIGURE 2: QuickMon gives you statistics on the performance of your cache (how many times the cache was able to prevent having to go to the CD-ROM drive for data).

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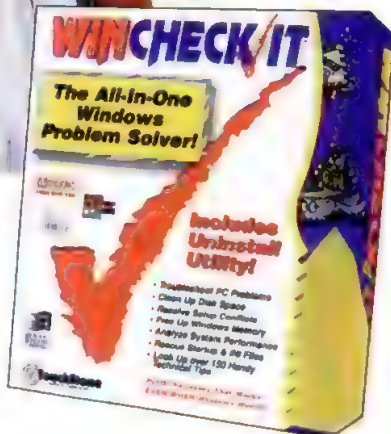
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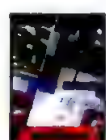
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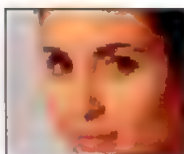
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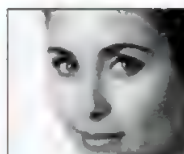
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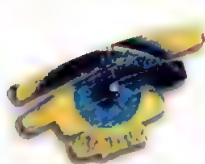
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How CD-Quick Works

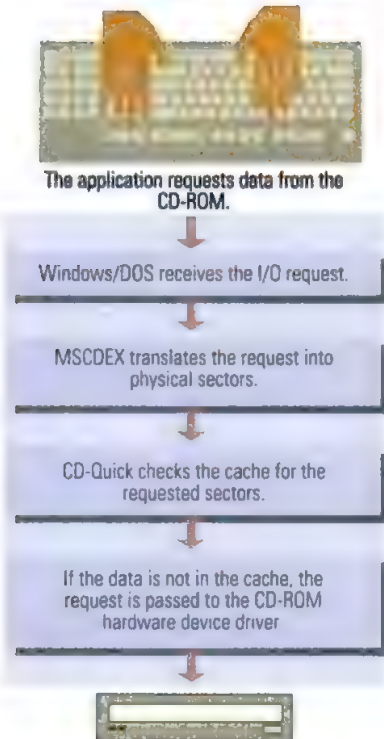


FIGURE 3: CD-Quick sits between MSCDEX and your hardware device driver, and either satisfies the data request from the cache or passes the request to the hardware driver.

these devices, you will flush the cache for all the devices. This is not as unusual a situation as you might think. It could occur with a common task like searching a hard disk with a File Find utility.

Another problem with using a single cache is that the optimal cache size for hard disks and CD-ROM drives is different—a result of their very different access speeds. A bigger cache is not always better; there is a point of diminishing returns. A too-large cache wastes memory and can actually reduce performance by taking too long to fill. The optimal cache size for a hard disk is much smaller than it is for a CD-ROM drive because of the former's quicker access times. A hard disk's performance can improve with a cache of only 512K, while a CD-ROM in the same system could benefit from a 2MB cache. When a single cache is used for both devices, neither device will be cached optimally.

The most important difference between CD-Quick and SmartDrive, however, is the manner in which CD-Quick handles read-ahead caching. CD-Quick is able to outperform SmartDrive on random reads because of SmartDrive's static read-ahead scheme. SmartDrive performs read-ahead buffering

every time you access the device. If you are reading sequentially, this improves performance. But SmartDrive never checks to see if you are reading sequentially—if you're reading data randomly from the CD, SmartDrive will spend time filling the cache with data you'll never access. This static read-ahead scheme is also used in Windows 95.

In contrast, CD-Quick dynamically adjusts the amount of data it reads ahead, depending on the pattern of your reads. If you are reading randomly from the CD, CD-Quick will drop the number of read-ahead sectors to zero. This clever approach is what makes CD-Quick better. CD-Quick's excellent documentation describes how you can demonstrate these differences between SmartDrive and CD-Quick using the CDTest utility.

CD-QUICK AND WINDOWS 95

CD-Quick installs as a TSR, but in fact it's a device driver that sits between MSCDEX (the Microsoft CD-ROM Extensions) and your CD-ROM drive's device driver. When an application requests data from a CD-ROM, the operating system passes the request to MSCDEX, which translates the request into physical sectors. CD-Quick then steps in and checks the cache for the requested sectors, returning them to the requesting application if found. If they are not found, CD-Quick passes the request through to the hardware device driver, which accesses the data (see Figure 3).

This technique does not work under Windows 95. One of the big changes in Windows 95 is a completely rewritten file system. There are separate file systems for disks and CD-ROMs, and all I/O is in 32-bit protected mode. A protected-mode driver that includes CD-ROM caching has replaced MSCDEX, but the maximum size of the cache is a little over 1MB, and read-ahead buffering is still static. SmartDrive has also been replaced with a protected-mode cache for hard and floppy disk drives.

When you install a CD-ROM drive, Windows 95 attempts to find a 32-bit protected-mode driver for it. In most cases, it can. If not, it will load the manufacturer-supplied 16-bit driver. CD-Quick will work under Windows 95 only if a 16-bit driver is controlling the CD-ROM drive. For new-style drivers, a different sort of approach is needed. Circuit Systems is working on a Windows 95 version of CD-Quick, tentatively scheduled for release in January 1996. □

CD-Quick Cache, Version 1.20. List price: \$29. Requires: DOS 3.1 or later, Microsoft Windows 3.1, 286 or better with 384K of extended memory, CD-ROM drive. Orders by check: Circuit Systems, 418 Church Rd., Sicklerville, NJ 08081-1727. Orders by credit card: PsL, P.O. Box 35705, Houston, TX 77235-5705; 800-242-4775; CompuServe, GO SWREG, ID #4214. Circle 531 on reader service card

Sheryl Canter is a contributing editor of PC Magazine.

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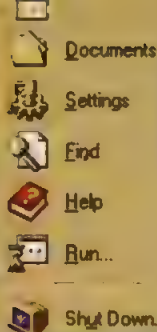
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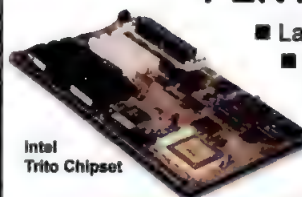
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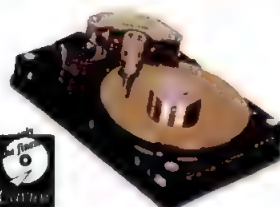


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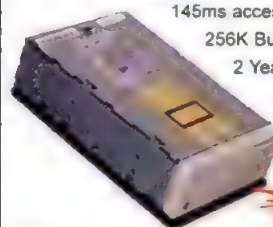
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Benchmark Testing: Advancing the Art

An inside look at the new Winstone 96 and WinBench 96 benchmarks.

With this issue's system and graphics adapter reviews, PC Magazine Labs introduces Winstone 96, Version 1.0, and WinBench 96, Version 1.0, the newest releases of our industry-standard PC benchmark tests. Both are the latest versions of the tools we've been using to evaluate PC performance for the past year. Winstone 96 and WinBench 96 are the end result of a year of development by the Ziff-Davis Benchmark Operation (ZDBOP), the research and development division of Ziff-Davis Publishing charged with creating benchmark tests for *PC Magazine* and other Ziff-Davis publications.

Winstone 96 is a significant new release of our Winstone software, the PC industry's leading application-based benchmark test suite. Like previous Winstone versions, Winstone 96 uses scripts that execute real Windows applications to produce an overall measure of a PC's performance under Microsoft Windows 3.x or Windows 95.

WinBench 96 acts as a companion to Winstone 96. WinBench 96 provides detailed information about how all of a PC's major subsystems—processor/RAM, graphics, disk, CD-ROM, and full-motion video playback—perform under either Windows 3.x or Windows 95.

BENCHMARK TEST BASICS

A few key concepts lie at the heart of both Winstone 96 and WinBench 96. Like previous releases, both are market-centered test suites. They aim to measure the level of performance typical users will achieve when performing common operations with leading software applications. The benchmark test results will be directly applicable to the vast majority of us, because most of us spend a great deal of our computing time working with the same basic classes of applications that the tests use.

That's not to say that the results of these benchmark tests will apply equally well to everyone or to every computing situation. If you spend all your time running CAD programs, the main scores these benchmark tests produce will not reflect your work. Even if you

are such a user, don't despair: In addition to its main tests, WinBench 96 provides literally hundreds of analysis tests that can help you gauge specific aspects of your PC's performance.

Winstone 96 and WinBench 96 take two different approaches to the job of measuring PC performance. Winstone 96 is an application-based benchmark test suite. It runs real applications through a series of scripted activities and measures the time a PC takes to complete those activities to produce the performance scores. WinBench 96, by contrast, is a synthetic test suite. It executes specially crafted program routines designed to model certain specific types of application behavior.

The challenge in creating a synthetic benchmark test suite like WinBench 96 is to make sure it really does act like the applications whose behavior it is supposed to reflect. The key to making this happen is *applications*

distributed by ZDBOP and *PC Magazine*, the user interfaces of this year's benchmark tests will initially look and feel quite familiar. Each uses the same basic interface and results-file formats as last year, although when run under Windows 95, both look like Windows 95 applications.

Two areas where we've significantly improved the benchmark tests are their system-configuration inspection tools and their cleanup facilities. In addition to fixing a few bugs, we've given both products the ability to detect more information about a PC's configuration. And should a PC lose power or otherwise encounter a problem during a benchmark test run, both products now automatically return the PC to its pretest configuration. All you have to do is restart Windows and the benchmark tests do the rest.

As in the past, both benchmark test suites

also include complete on-line documentation. The combination of a short testers' handbook that contains all the facts you need to start a test run, a reference manual running hundreds of pages in length, and an on-line help facility makes it easy for you to learn a great deal about each test suite.

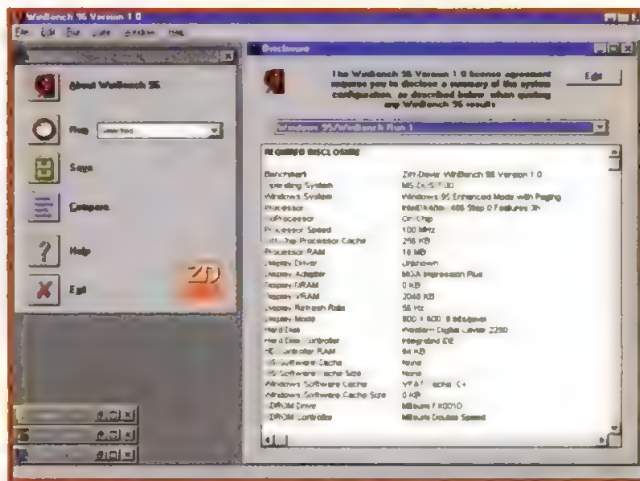
UNDERSTANDING THE CHANGES

The industry changes, and our benchmark tests must change to reflect that. Windows 95 now dominates the PC operating-system landscape. New versions of applications are appearing, and these put different performance demands on PCs than previous versions did.

These changes made the upgrade to our benchmark tests necessary. The good news is that unlike most upgrades, this one is free (see the sidebar "How to Get Copies of the New Benchmark Tests").

PC Magazine will be using only these new versions from this issue onward. We encourage vendors to do the same, and so should you. If a vendor tries to quote you old benchmark test results, demand scores based on the new releases.

Longtime readers may note that, for the

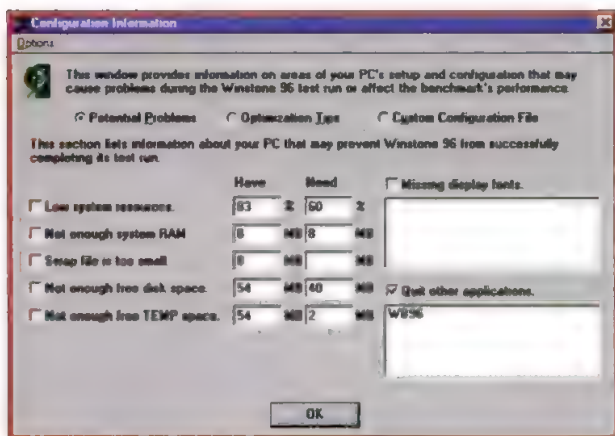


WINBENCH 96 (shown here) and **Winstone 96** provide extensive information that gives a good picture of the PC being tested. Benchmark test results without system configuration details are confusing at best and misleading at worst.

profiling, a process of logging and analyzing the way the actual target applications behave. To build WinBench 96, ZDBOP profiled the processor, graphics, disk, and CD-ROM activity of 13 leading Windows applications.

GETTING STARTED

If you worked with one of the more than 2 million copies of last year's benchmark tests



THIS YEAR'S BENCHMARK TESTS are more robust than ever before. For example, Winstone 96 (shown here) and WinBench 96 help you spot areas of your PC's configuration that might cause problems while your system is running the benchmark tests.

first time, we are not introducing a new version of our DOS-based benchmark test suite, PC Bench. The current release of that test suite, PC Bench 9.0, will still be available for several months through PC Magazine Online, but as the PC market leaves DOS behind and moves on to Windows, so too do our benchmark tests.

As our benchmark tests evolve to reflect today's applications and technologies, an unavoidable side effect is that the results they produce also change. Results from Winstone 96, Version 1.0, and WinBench 96, Version 1.0, are not comparable with the results of any previous benchmark tests, not even with the results of an earlier version of the same benchmark tests. You cannot, for example, meaningfully compare the results of Winstone 96 and last year's Winstone 95.

Don't be surprised, by the way, if scores on these new benchmark tests rise over time as vendors use them as a tool to build better, faster systems. Today's top performer on Winstone 96 is likely to be tomorrow's average performer, and that's as it should be. New technologies and the efforts of vendors to improve performance gauged by the benchmark tests produce faster systems, something that is a win for all of us.

GET CONSISTENT, ACCURATE RESULTS

Producing test results with either Winstone 96 or WinBench 96 is simple: Just install the tests and click on the Run button. Making sure you achieve the most accurate and useful results possible requires a good deal more care. Not only your operating procedures but system configuration options such as disk cache size will affect your benchmark test results—just as they affect your real-world performance.

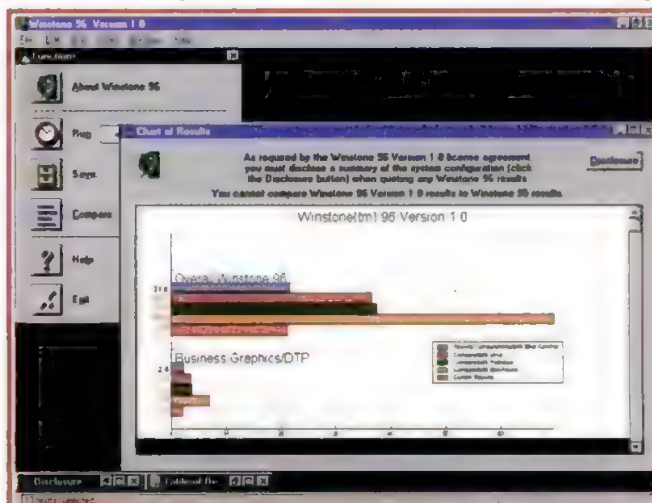
We employ a basic set of standard

testing procedures, outlined in the benchmark test manuals, which we also recommend you follow. The dual intent of these procedures is to ensure that benchmark test results accurately gauge your system's performance potential and that the results are highly repeatable.

If you follow the procedures, none of the major scores of either benchmark test suite will vary by more than a few percent across multiple runs on the same PC. As a minimum, you should try to defragment the PC's disk and reboot the system before each bench-

mark test run, and you should not have any other applications active when you run either test suite.

Even after you've followed good testing procedures and produced a set of benchmark test results, you're still only part of the way toward getting value from the tests. What you're missing is context: Benchmark test results are rarely meaningful in isolation. This is part of the reason our reviews always provide multiple results and a great deal of configuration information about the PCs and peripherals we tested. Multiple sets of results give you the opportunity to make meaningful comparisons, and the configuration information helps you understand the ranges of results produced by different types of PCs. Vendors that quote benchmark test results should also provide similar configuration information. In fact, the license agreements for our benchmark tests require them to do just that.



THE WINSTONE 96 USER INTERFACE will be familiar if you've used Winstone 95 before. But this year's Winstone also reflects the UI differences introduced by Windows 95.

The final step in getting the most from the benchmark tests is to make meaningful comparisons. If, for example, your goal is to compare the performance of two graphics adapters, test both adapters in the same system or in two identical systems. If you test the boards in different systems, the differences in those systems will affect the benchmark test results.

WINSTONE 98

Winstone 96 measures PC performance by running actual Windows applications. Because most applications in use today are still 16-bit, Winstone 96 uses 16-bit Windows applications. As the market moves to 32-bit applications, we will introduce new 32-bit versions of Winstone.

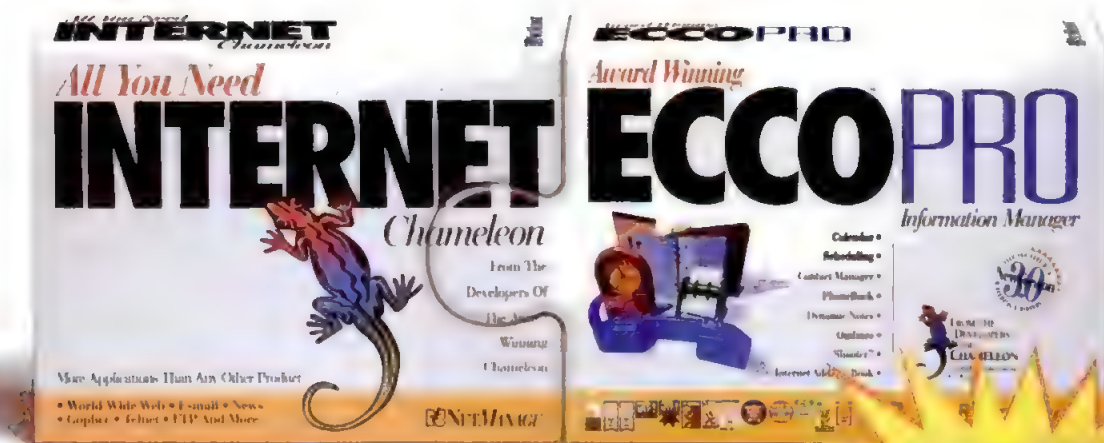
To determine which applications to use in Winstone 96, we consulted with Computer Intelligence/InfoCorp (CII), a leading market research company (and a division of Ziff-Davis). We chose applications with the largest unit market shares by averaging actual application sales for 1995 to date with projections for 1996 that CII prepared for use with Winstone 96. The results led us to select the following 13 applications in four categories:

- **Spreadsheet:** Lotus 1-2-3 Release 5.0 for Windows, Microsoft Excel 5.0c for Windows, Microsoft Works 3.0a for Windows, Novell's Quattro Pro 6.0 for Windows.
- **Word Processing:** Lotus's Ami Pro Release 5.0 for Windows, Microsoft Word 6.0c for Windows, Microsoft Works 3.0a for Windows, Novell's WordPerfect 6.1 for Windows.
- **Database:** Borland's dBASE 5.0 for Windows, Borland's Paradox for Windows 5.0, Microsoft Access 2.0c for Windows, Microsoft Works 3.0a for Windows.
- **Business Graphics/Desktop Publishing:** Adobe's PageMaker for Windows 5.0a, Corel Systems Corp.'s CorelDraw 5.0b, Microsoft PowerPoint 4.0c for Windows.

Notice that one application on this list, Microsoft Works, appears in three categories. To reflect the way people use this multifunction product, Winstone 96 spreads its effects across the Spreadsheet, Word Processing, and Database categories (40 percent of its weight goes to the Spreadsheet category, another 40 percent to the Word Processing category, and the remaining 20 percent goes to the Database category).

Earlier versions of almost all these applications were also used in the Winstone 95

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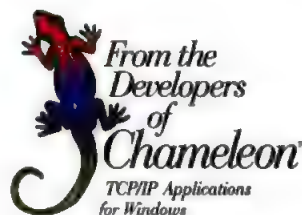
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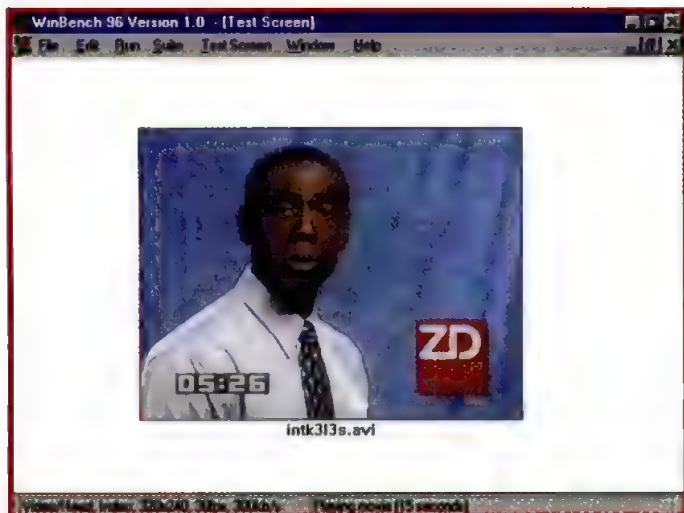
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NEW CAPABILITIES IN WINBENCH 96 include tests for CD-ROM, processor, and full-motion video performance. Both the clip above and an action clip are available on the PC Benchmark Tests CD in a variety of sizes and frame rates using both Indeo and CinePak.

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As you might expect from a test suite that executes 13 leading Windows applications, Winstone 96 is big. It consists of about 100MB of data, so on-line and disk distribution is not really an option. Like its predecessor, Winstone 96 is available only on CD-ROM.

You can run Winstone 96 three ways: from a local hard disk, from a CD-ROM drive attached to the PC you're testing, or from a network server. In each case, Winstone 96 copies to a working directory (which should be on the PC you're testing) the files each application needs to run, and then it runs that application's script from that directory. Winstone 96's internal timing mechanisms ensure that all three methods produce the same result on a given PC. Regardless of testing configuration, Winstone 96 requires at least 8MB of system RAM to execute.

HIGHLIGHTS

Winstone 96 and WinBench 96

► Winstone 96's application-based tests are founded on the results of one of the most extensive surveys of application usage ever performed. Nearly 4,000 readers selected at random filled out a ten-page survey of their applications-usage characteristics.

► Winstone 96 is based on new application market-share data for 1995 and projections for 1996.

► Winstone 96 contains a dramatically improved cleanup system, so it can return your system to its original state even after such extreme events as a power loss while running the benchmark tests.

► Winstone 96 and WinBench 96 pro-

vide more detailed information about your system's configuration than ever before.

► WinBench 96 features new Windows-based tests for processor subsystem performance: CPUmark₁₆ for 16-bit performance and CPUmark₃₂ for 32-bit performance.

► WinBench 96 introduces our first publicly available CD-ROM tests. The CD-ROM WinMark tests are based on profiles of CD-ROM drive usage when running leading CD-ROM applications. Additional CD-ROM tests let you measure a system's CD-ROM read-and-seek performance.

► WinBench 96 provides our first

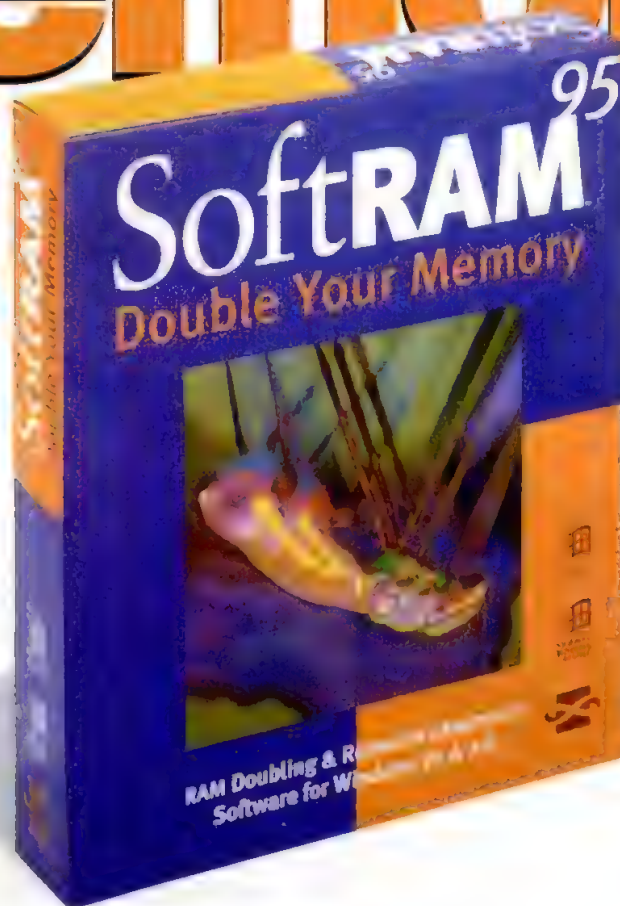
publicly available full-motion video tests. Several dozen different tests let you gauge a system's performance when playing back typical video clips at many different rates using either Indeo or Cinepak codecs.

► WinBench 96's updated Graphics WinMark 96 tests are based on extensive profiling of graphics activity when running leading Windows applications.

► WinBench 96's new Disk WinMark 96 tests replay the disk activity of the Winstone 96 applications.

► Winstone 96 and WinBench 96 run both on Windows 3.x and as 16-bit applications on Windows 95.

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How to Get Copies of the New Benchmark Tests

If you would like a copy of WinBench 96, you can download it from either PC Magazine Online (GO UTILFORUM on CompuServe's ZD Net) or the Ziff-Davis Benchmark Operation (GO ZDBENCH on CompuServe), or from the ZDBOp home page on the World-Wide Web (<http://www.zd.com/~zdbop/>).

This version does not contain the new CD-ROM or video performance tests, however. The required files are simply

too large for downloading.

Winstone 96, at about 100MB, is also not available for downloading. For a copy of the CD-ROM containing complete versions of both benchmark test suites, send a postcard to the following address:

Ziff-Davis Benchmark Operation
1001 Aviation Parkway, # 400
Morrisville, NC 27560
ATTN.: Distribution Coordinator

You can also fax your request to 919-380-2879. With all requests, please include your name, address, phone number, and the fact that you want the PC Benchmark Tests CD-ROM. Please allow four to six weeks for delivery. For faster delivery, enclose your Federal Express account number and Federal Express shipping instructions.

The CD-ROM includes on-line copies of the manual for each benchmark test suite.

WINBENCH 96

WinBench 96 provides both the familiar Graphics WinMark and Disk WinMark tests and many new tests that let you measure the performance of a PC's processor/RAM, CD-ROM, and full-motion video subsystems.

Historically, WinBench's most widely used score has been the Graphics WinMark. The tests that produce that score are the result of exhaustive profiling of the graphics operations of the Winstone applications. The Graphics WinMark 96 score is the product of 13 different tests, each of which involves a mix of different graphics operations. A total of 115 different operations make up these 13 tests.

These operations are a statistical representation of the ones the Winstone 96 applications perform during the course of the Winstone 96 scripts. The operations range from visible functions, such as painting lines on the screen, to those you cannot see, such as writing to off-screen memory and clipping. The frequency and parameters of each operation, as well as the weight of each, come from the Winstone 96 profile data. Each operation plays the same role in the Graphics WinMark 96 score as it does in the overall graphics performance of Winstone 96.

The Graphics WinMark score is by no means, however, the same as any of Winstone 96's scores. WinBench 96 produces the Graphics WinMark score by running a series of practically nonstop graphics stress tests. It is significantly harsher on a PC's graphics subsystem than Winstone 96, whose applications spend only part of their time performing graphics operations.

The other long-standing subset of WinBench is the Disk WinMark tests. WinBench 96's Disk WinMark 96 uses the same basic Disk Mix technology we introduced last year to replay all the timed application disk activity in Winstone 96. In the course of these operations, the tests use dozens of directories, hundreds of files, and nearly 60MB of disk space.

ADDITIONAL WINBENCH TESTS

Joining the graphics and disk benchmark tests are three new sets of tests that let you

gauge the performance of a PC's processor/RAM, CD-ROM, and full-motion video subsystems.

WinBench 96 offers two new test suites for measuring processor subsystem performance: CPUmark₁₆ and CPUmark₃₂. The difference between these is the type of applications we profiled to construct them. CPUmark₁₆ is a 16-

As 32-bit Windows 95
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bit test suite that reflects processor usage under 16-bit applications, while CPUmark₃₂ is a 32-bit test suite that mirrors processor behavior when running 32-bit applications. We'll be looking at both measures during our system testing; whether one or both are appropriate to you depends on the mix of 16- and 32-bit applications you run.

To let you measure the speed of a PC's CD-ROM subsystem, WinBench 96 provides the new CD-ROM WinMark 96 tests. These tests use a mix of CD-ROM operations based on the profiles of six leading CD-ROM applications in three categories: Business/Productivity, Games/Entertainment, and Reference/Education. If you are interested in low-level CD-ROM performance data, you'll also find a large assortment of additional CD-ROM read-and-look tests in WinBench 96. (To run any of these CD-ROM tests, you must have the PC Benchmark Tests CD in your CD-ROM drive.)

In addition to the tests for CD-ROM throughput and access time, one new test measures processor utilization during sustained

CD-ROM read operations. This measure is important because it lets you know how much of the PC's processor power the CD-ROM subsystem consumed while running the tests. The lower the processor utilization the better, because more processing power is then available for other types of work.

The final group of new tests in WinBench 96 provides a measure of how well a PC can handle full-motion video. WinBench 96 lets you test video playback performance with two representative video clips (one of a person talking and the other of a moving carousel), at a variety of data rates and frame rates and with either the Indeo or Cinepak codec. Each of these tests provides four major results: the number of frames dropped during playback, the number of audio breaks during playback, the processor utilization, and the percent of nominal playback speed. For the first three results, lower scores are preferable. Ideally, a PC should be able to play back each clip without dropping any frames, with no breaks in the audio track, and with little help from the PC's main processor. The fourth result simply indicates how close to ideal playback speed the PC came; 100 percent is the ideal.

The combination of these new tests with the updated Graphics and Disk WinMark tests gives WinBench 96 the most comprehensive set of PC subsystem performance measures available.

EYES ON THE FUTURE

We're already working on the benchmark tests for next year. As 32-bit Windows 95 applications become the norm, our benchmark tests will evolve to model their behavior accurately. Intel's P6 is on the way, as are many Pentium and P6 competitors. As these and other developments unfold, we'll be busy creating the benchmark tests necessary to help you and us cope with them. □

Mark L. Van Name is vice president, product testing of Ziff-Davis Publishing. Bill Catchings is director of the Ziff-Davis Benchmark Operation.

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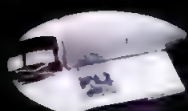
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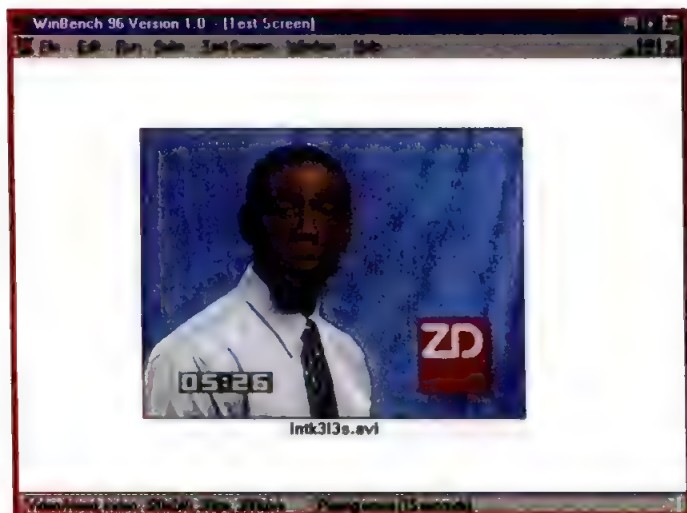
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Again, don't try to compare Winstone 96 scores with those from Winstone 95. The two benchmark test suites use different sets of applications, different versions of the same applications, different scripts, and different unit market-share weights. In addition, because Winstone 96 uses a reference machine with more RAM and a faster CPU than last year's reference machine, Winstone 96 scores are numerically lower than Winstone 95 scores. That change does not in any way mean that PCs are now slower; it just reflects the faster reference machine.

As you might expect from a test suite that executes 13 leading Windows applications, Winstone 96 is big. It consists of about 100MB of data, so on-line and disk distribution is not really an option. Like its predecessor, Winstone 96 is available only on CD-ROM.

You can run Winstone 96 three ways: from a local hard disk, from a CD-ROM drive attached to the PC you're testing, or from a network server. In each case, Winstone 96 copies to a working directory (which should be on the PC you're testing) the files each application needs to run, and then it runs that application's script from that directory. Winstone 96's internal timing mechanisms ensure that all three methods produce the same result on a given PC. Regardless of testing configuration, Winstone 96 requires at least 8MB of system RAM to execute.

HIGHLIGHTS

Winstone 96 and WinBench 96

► Winstone 96's application-based tests are founded on the results of one of the most extensive surveys of application usage ever performed. Nearly 4,000 readers selected at random filled out a ten-page survey of their applications-usage characteristics.

► Winstone 96 is based on new application market-share data for 1995 and projections for 1996.

► Winstone 96 contains a dramatically improved cleanup system, so it can return your system to its original state even after such extreme events as a power loss while running the benchmark tests.

► Winstone 96 and WinBench 96 pro-

vide more detailed information about your system's configuration than ever before.

► WinBench 96 features new Windows-based tests for processor subsystem performance: CPUmark₁₆ for 16-bit performance and CPUmark₃₂ for 32-bit performance.

► WinBench 96 introduces our first publicly available CD-ROM tests. The CD-ROM WinMark tests are based on profiles of CD-ROM drive usage when running leading CD-ROM applications. Additional CD-ROM tests let you measure a system's CD-ROM read-and-seek performance.

► WinBench 96 provides our first

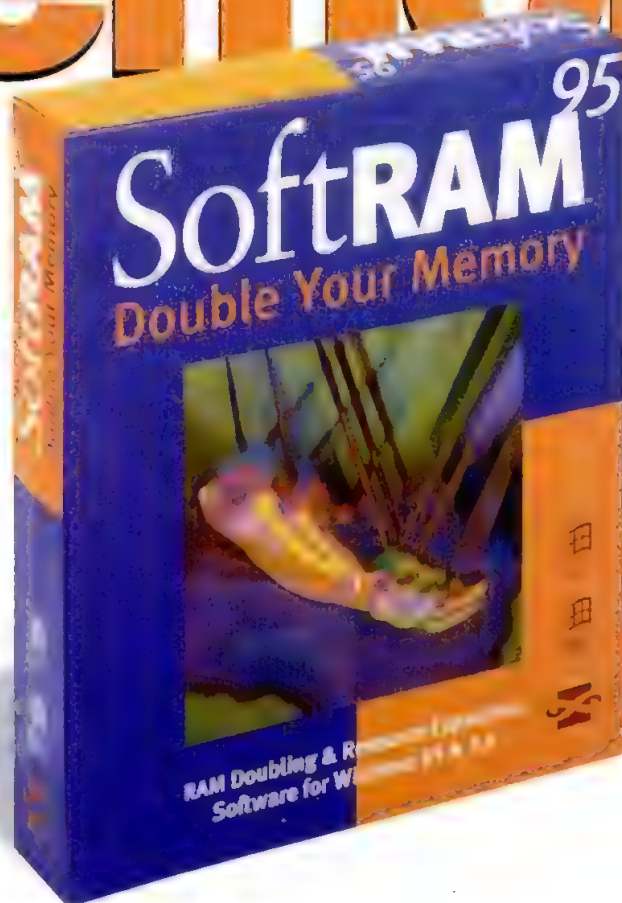
publicly available full-motion video tests. Several dozen different tests let you gauge a system's performance when playing back typical video clips at many different rates using either Indeo or Cinepak codecs.

► WinBench 96's updated Graphics WinMark 96 tests are based on extensive profiling of graphics activity when running leading Windows applications.

► WinBench 96's new Disk WinMark 96 tests replay the disk activity of the Winstone 96 applications.

► Winstone 96 and WinBench 96 run both on Windows 3.x and as 16-bit applications on Windows 95.

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SoftRAM⁹⁵ is now at resellers everywhere or direct from 1-800-691-7981.

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How to Get Copies of the New Benchmark Tests

If you would like a copy of WinBench 96, you can download it from either PC Magazine Online (GO UTILFORUM on CompuServe's ZD Net) or the Ziff-Davis Benchmark Operation (GO ZDBENCH on CompuServe), or from the ZDBop home page on the World-Wide Web (<http://www.zd.com/~zdbop/>).

This version does not contain the new CD-ROM or video performance tests, however. The required files are simply

too large for downloading.

Winstone 96, at about 100MB, is also not available for downloading. For a copy of the CD-ROM containing complete versions of both benchmark test suites, send a postcard to the following address:

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ATTN.: Distribution Coordinator

You can also fax your request to 919-380-2879. With all requests, please include your name, address, phone number, and the fact that you want the PC Benchmark Tests CD-ROM. Please allow four to six weeks for delivery. For faster delivery, enclose your Federal Express account number and Federal Express shipping instructions.

The CD-ROM includes on-line copies of the manual for each benchmark test suite.

WINBENCH 96

WinBench 96 provides both the familiar Graphics WinMark and Disk WinMark tests and many new tests that let you measure the performance of a PC's processor/RAM, CD-ROM, and full-motion video subsystems.

Historically, WinBench's most widely used score has been the Graphics WinMark. The tests that produce that score are the result of exhaustive profiling of the graphics operations of the Winstone applications. The Graphics WinMark 96 score is the product of 13 different tests, each of which involves a mix of different graphics operations. A total of 115 different operations make up these 13 tests.

These operations are a statistical representation of the ones the Winstone 96 applications perform during the course of the Winstone 96 scripts. The operations range from visible functions, such as painting lines on the screen, to those you cannot see, such as writing to off-screen memory and clipping. The frequency and parameters of each operation, as well as the weight of each, come from the Winstone 96 profile data. Each operation plays the same role in the Graphics WinMark 96 score as it does in the overall graphics performance of Winstone 96.

The Graphics WinMark score is by no means, however, the same as any of Winstone 96's scores. WinBench 96 produces the Graphics WinMark score by running a series of practically nonstop graphics stress tests. It is significantly harsher on a PC's graphics subsystem than Winstone 96, whose applications spend only part of their time performing graphics operations.

The other long-standing subset of WinBench is the Disk WinMark tests. WinBench 96's Disk WinMark 96 uses the same basic Disk Mix technology we introduced last year to replay all the timed application disk activity in Winstone 96. In the course of these operations, the tests use dozens of directories, hundreds of files, and nearly 60MB of disk space.

ADDITIONAL WINBENCH TESTS

Joining the graphics and disk benchmark tests are three new sets of tests that let you

gauge the performance of a PC's processor/RAM, CD-ROM, and full-motion video subsystems.

WinBench 96 offers two new test suites for measuring processor subsystem performance: CPUmark₁₆ and CPUmark₃₂. The difference between these is the type of applications we profiled to construct them. CPUmark₁₆ is a 16-

As 32-bit Windows 95 applications become the norm, our benchmark tests will evolve to model their behavior accurately.

bit test suite that reflects processor usage under 16-bit applications, while CPUmark₃₂ is a 32-bit test suite that mirrors processor behavior when running 32-bit applications. We'll be looking at both measures during our system testing; whether one or both are appropriate to you depends on the mix of 16- and 32-bit applications you run.

To let you measure the speed of a PC's CD-ROM subsystem, WinBench 96 provides the new CD-ROM WinMark 96 tests. These tests use a mix of CD-ROM operations based on the profiles of six leading CD-ROM applications in three categories: Business/Productivity, Games/Entertainment, and Reference/Education. If you are interested in low-level CD-ROM performance data, you'll also find a large assortment of additional CD-ROM read-and-seek tests in WinBench 96. (To run any of these CD-ROM tests, you must have the PC Benchmark Tests CD in your CD-ROM drive.)

In addition to the tests for CD-ROM throughput and access time, one new test measures processor utilization during sustained

CD-ROM read operations. This measure is important because it lets you know how much of the PC's processor power the CD-ROM subsystem consumed while running the tests. The lower the processor utilization the better, because more processing power is then available for other types of work.

The final group of new tests in WinBench 96 provides a measure of how well a PC can handle full-motion video. WinBench 96 lets you test video playback performance with two representative video clips (one of a person talking and the other of a moving carousel), at a variety of data rates and frame rates and with either the Indeo or Cinepak codec. Each of these tests provides four major results: the number of frames dropped during playback, the number of audio breaks during playback, the processor utilization, and the percent of nominal playback speed. For the first three results, lower scores are preferable. Ideally, a PC should be able to play back each clip without dropping any frames, with no breaks in the audio track, and with little help from the PC's main processor. The fourth result simply indicates how close to ideal playback speed the PC came; 100 percent is the ideal.

The combination of these new tests with the updated Graphics and Disk WinMark tests gives WinBench 96 the most comprehensive set of PC subsystem performance measures available.

EYES ON THE FUTURE

We're already working on the benchmark tests for next year. As 32-bit Windows 95 applications become the norm, our benchmark tests will evolve to model their behavior accurately. Intel's P6 is on the way, as are many Pentium and P6 competitors. As these and other developments unfold, we'll be busy creating the benchmark tests necessary to help you and us cope with them. □

Mark L. Van Name is vice president, product testing of Ziff-Davis Publishing. Bill Catchings is director of the Ziff-Davis Benchmark Operation.

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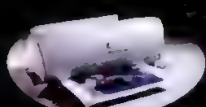
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TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

User-to-User

By Neil J. Rubenking

ECHOing Embedded Redirection Symbols

The item "Redirection Symbols in Batch Files" (*User-to-User*, April 11, 1995) erroneously states that the ECHO command can't be used to build a secondary batch file whose lines contain redirection symbols. Here's what I've discovered:

- ECHO will successfully write any string if it interprets all characters as text characters.
- The double-quote character functions as a delimiter between text characters and executable characters.
- Redirection characters will be treated as text characters if they are enclosed in double quotes.

The double-quote characters must be interpreted as delimiters of a text string in the primary batch file but as the name of an empty environment variable in the secondary batch file. Thus, the example line from the original item would be expressed as:

```
ECHO %""% FIND /I "foobar" < IN.  
->FIL >> OUT.FIL %""% > SECONDRY.BAT
```

And the resulting line in the secondary batch file would be:

```
%""% FIND /I "foobar" < IN.FIL >>  
->OUT.FIL %""%
```

The string % "" is replaced by the value of the environment variable whose name is a single double-quote character; you must make sure this environment variable is empty.

In most cases, you can simply put the string % "" before and after the string to be echoed to the secondary batch file. This works even when that string contains double quotes, as long as the number of double quotes is even and as long the string doesn't contain quoted redirection characters.

If the string does contain an odd number of double quotes, you can add an extra % "" string just before or after the unpaired quote mark. Or, if you can do so without leaving a redirection character outside the quoted text, delete the % "" string at the start of the line. If there are quoted redirection characters in the original string, use mul-

tipl pairs of % "" strings, placed so that the existing quoted redirection characters do not fall between a pair. Here are two example lines:

```
ECHO ECHO This is a single quote  
-> ". > OUT.FIL %""% >> SECONDRY.BAT
```

```
ECHO FIND ">" %""% < IN.FIL | %""%  
->FIND /V "<" %""% >> OUT.FIL %""% >>  
->SECONDRY.BAT
```

The secondary batch file resulting from these two lines is:

```
ECHO This is a single quote ". >  
->OUT.FIL %""%
```

```
FIND ">" %""% < IN.FIL | %""% FIND /V  
->"<" %""% >> OUT.FIL %""%
```

Again, the string % "" is replaced by nothing, because the environment variable named " is empty.

If you're interested in writing advanced batch files, it's a good idea to study the DOS reserved characters. Each has more than one useful purpose in a batch file.

DALE EDGETT, San Mateo, California

PC MAGAZINE: It's amazing—there are still brand-new techniques to be discovered in creaky old DOS! The fact that ECHO will successfully process redirection characters if they're enclosed in quotes isn't news. The problem has always been that the quotes show up in the secondary batch file as well, rendering the generated commands useless. Mr. Edgett's unique solution lies in discovering a means to use quotes in the primary batch file yet have them disappear in the secondary one.

The key to this solution is DOS's special processing of the % character in a batch file. This character actually has three distinct uses. When the % character is followed by a number, DOS replaces it with the value of the corresponding command line parameter. In the FOR command, % plus a letter represents a variable that takes on each value in the FOR list. And when two % characters surround a string, DOS replaces it with the value of the environment variable named by that string.

HIGHLIGHTS



HARDWARE Computers connected to telephone lines are susceptible to lightning bolts. Here's how to protect yourself. Page 434



WORD PROCESSING Learn how to attach words to Word 6.0 macros and commands, and gain an understanding of WordBasic's Declare statement along the way. Page 448



SPREADSHEETS Find out how you can compensate for the way binary computers store your decimal numbers. Page 448

OUR ADVISORS

Douglas Boling is a contributing editor and the author of many PC Magazine utilities.

Frank J. Derfler, Jr. is senior networking editor and the author of the PC Magazine Guide to Connectivity.

Alfred Poor is a contributing editor and the author of *The Underground Guide to Hardware*.

Brian Proffitt is a senior contributing editor to OS/2 Magazine and author of *OS/2 Application Development Tools*.

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To use a plain % character within a batch file, you must enter two of them: % %.

Thus when DOS processes the key string % % " % %, the pairs of % characters reduce to single % characters, so the string becomes % " %. When this reduced string is processed by DOS in the secondary batch file, DOS replaces it with the value of the environment variable whose name is a double quote; as noted, your batch file needs to make sure this variable is empty. As required, the quotes effectively disappear in the secondary batch file.

If the line of text after the ECHO command contains multiple pairs of double quotes, the text within each pair is quoted text, but the text between different pairs is not quoted text. For example:

```
ECHO "quoted" not quoted "quoted"
```

That's why special handling is needed when the command to be echoed into a secondary batch file contains an odd number of quotes or contains quoted redirection symbols. This technique, while complex, is easier to use and more versatile than the previous solution, which involved using PROMPT meta-characters to represent redirection symbols. I'm sure you'll find many uses for it.

Easier Troubleshooting in Windows

Here are several troubleshooting shortcuts that have proved invaluable to me both in Windows 3.1 and in Windows for Workgroups (WfWG).

- **WIN /3**—Tries to force Windows into Enhanced mode (not necessary in WfWG).
- **WIN /S**—Tries to force Windows into Standard mode (not possible in WfWG).
- **WIN /B**—Creates a file called **BOOTLOG.TXT** that records the Windows start-up procedure, including any failure to load devices or files. Look for it in the Windows directory.
- **WIN /N**—Prevents Windows from loading network drivers (WfWG only).
- **WIN /D**—A general troubleshooting command that may be followed by any or all of the switches listed below. If Windows balks at start-up, you may want to use all the switches at once as the first step in troubleshooting.
- **/D:C**—Turns off 32-bit file access (WfWG only).
- **/D:F**—Turns off 32-bit disk access; equivalent to the **SYSTEM.INI** setting **32BitDiskAccess=FALSE**.
- **/D:S**—Specifies that Windows should not use ROM address space between **F000:0000** and **1MB** for a break point; equivalent to the **SYSTEM.INI** setting **SystemROMBreakPoint=FALSE**.
- **/D:V**—Specifies that the ROM routine will

handle interrupts from the hard disk controller; equivalent to the **SYSTEM.INI** setting **VirtualHDIRQ=FALSE**.

- **/D:X**—Excludes all of upper memory from the range Windows scans to find free memory; equivalent to the **SYSTEM.INI** setting **EMMExclude=A000-FFFF**.

- **/D:T**—Starts Windows in "troubleshooting" mode, that is, with no virtual device drivers (VxDs) loaded. Use this if you suspect VxD conflict. Note that in this mode you cannot run

**System changes produced
by command line switches
are transitory: Just run
Windows again without
the switches and a system
returns to its former state.**

any DOS or communications software (WfWG only).

If you first replace your video driver with the standard Windows VGA driver and then use these command line switches, you'll be able to identify and perhaps solve most problems.

WARREN LARSON,
Shadow Hills, California

PC MAGAZINE: Driver or memory conflicts in your Windows setup may prevent you from running Windows at all. You may see the logo screen and then either get dumped unceremoniously back to DOS or find the system locked up at a black screen. Or Windows may refuse to load at all. In such situations, it's faster and easier to experiment with these command line switches than it is to fiddle with **SYSTEM.INI** settings again and again. And remember, **SYSTEM.INI** changes remain in effect until you change them back. System changes produced by command line switches, on the other hand, are transitory: Just run Windows again without the switches and your system returns to its former state.

Before starting a troubleshooting session, use the DOS-based Windows **SETUP** program to change your video driver to the plain VGA driver that comes with Windows. Video drivers are often implicated in driver conflicts, so it makes sense to drop back to a standard, reliable driver before beginning your investigation. And note that the facilities disabled by the **/D:T** troubleshooting switch include all access to the 386 Enhanced features of your system. Bring up Control Panel and you won't even see the 386Enh icon!

Copying an Entire Directory Structure

Sometimes it's necessary to copy a complete directory structure, either from drive X; to drive Y; or from subdirectory A to subdirectory B. But this can be a daunting experience as you try to keep all the file and directory names straight and not lose anything in the process. It occurred to me that **PKZIP** and the **NUL** device (which exists in every directory) can be used together to create a subdirectory builder wherever you want. **PKZIP** can capture an entire subdirectory tree—to be replicated anywhere else—with the command:

```
PKZIP -a -ex -rp DTREE.ZIP nul.*
```

Then switch to the directory in which you want these subdirectories replicated and issue the command:

```
PKUNZIP -d DTREE.ZIP
```

You've now created a duplicate set of directories in no time, exactly where you wanted.

WILLIAM FLETCHER, Tucson, Arizona

PC MAGAZINE: You can actually simplify the initial command to

```
PKZIP -rp DTREE.ZIP nul
```

The **-a** switch is superfluous as it just tells **PKZIP** to add files (the default behavior), and the **-ex** switch, for extra compression, is irrelevant because the regular compression method yields the smallest possible file. Do note that when you decompress a directory structure stored in this way, you'll get a "Warning! Invalid filename:" message for each directory. Just ignore these messages.

If you just want to copy a directory structure from one drive or subdirectory to another without storing it, there's an even faster way. Suppose you want to copy the directory structure of **C:\WINDOWS** to the new directory **D:\WINDOWS**. This command will do it:

```
XCOPY C:\WINDOWS\$$$$$$$$$.$$$  
D:\WINDOWS /s /e
```

\$\$\$\$\$\$\$\$\$.\$\$\$ is intended to be a nonexistent filename. If you actually have a file with this name, substitute a filename that doesn't exist on your system. When **XCOPY** asks whether **D:\WINDOWS** represents a file or a directory, press **D** for directory. **XCOPY** will return quickly, reporting that it copied 0 files, but you'll find that it did in fact create the complete directory structure. The **/s** switch tells **XCOPY** to find and copy matching files in all subdirectories, and the **/e** switch tells it to copy subdirectories even if they're empty.



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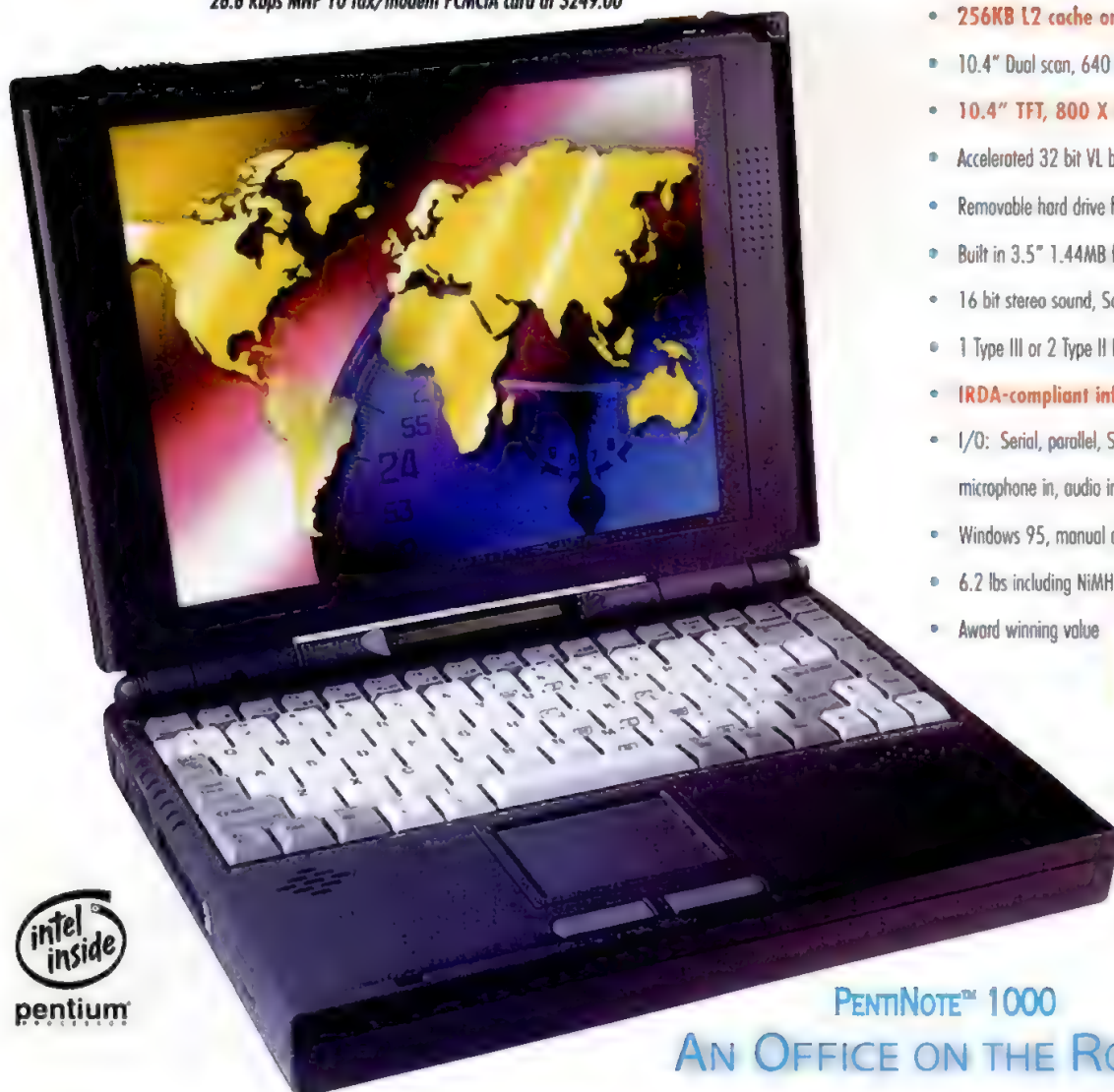
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Ask Our Advisors

HARDWARE

Upgrading Your UART, Revisited



In your column of May 30, 1995, reader Harry League asked whether he could upgrade the 8250 UARTs in his computer. Your reply suggested that the only way to upgrade was to purchase a new serial board containing a 16550 UART—but that's not the case. The correct answer is that if the 8250s are in sockets, just unplug them and plug in 16550As (at less than \$15 each).

DAVE BURTON, via the Internet

PC MAGAZINE: A number of readers have written to offer their views on this topic. Many joined Mr. Burton in pointing out that the 16550 UARTs are pin-compatible with 8250 and 16450 chips. It is true that if these slower chips are not soldered in place on the motherboard or serial card, you can indeed replace them with the faster 16550 chips.

On some motherboards or expansion cards, however, the chips are soldered in

place, making their removal more difficult than the upgrade is worth. And many motherboards don't use these chips at all; the UART functions are built into an integrated circuit chip with a totally different form factor. In this case, an expansion card is the only choice.

In the end, \$40 for a new I/O card versus \$30 for a pair of separate replacement chips makes the difference in price negligible, and for many users, installing a new board may be easier than replacing the chips.

—Alfred Poor

Mouse vs. Keyboard

I have a Microsoft serial mouse attached to COM1. Everything was working fine—until I installed new versions of the drivers. Now my mouse is okay in Windows, but when I exit Windows, the DOS prompt seems to be frozen. And if I press the Enter key, my printer spews forth an endless stream of "C\A" followed by about ten blank lines. I know how to solve the problem: If I change the Windows setup to the standard Microsoft Mouse and then edit the [386Enh] section of SYSTEM.INI to replace "keyboard=c:\mouse\mousekvd

.386" with "keyboard=*vkd", the problem goes away. But why do I have the problem in the first place?

SHANNON BROSKIE, Richmond, Virginia

PC MAGAZINE: According to Microsoft, the problem occurs because the virtual keyboard driver MOUSEKVD.386 conflicts with hardware that's been configured to use IRQ 12. This is because the driver is designed for a PS/2-style mouse, and the PS/2-style mouse port is designed to use IRQ 12. So if you have other hardware configured to use that interrupt—such as a sound card or other controller—you may encounter conflicts and unexpected results. Reconfiguring the other cards in your system might eliminate the problem.

On the other hand, the new virtual keyboard driver is required only for the PS/2-style mouse. According to Microsoft, a serial mouse will work just as well with the *vkd parameter in SYSTEM.INI—as you've already discovered. So your solution is just fine.

—Alfred Poor

Phone-Line Protection

I recently read that phone lines are susceptible to high-voltage power surges that can destroy computer systems as well as phones and an-

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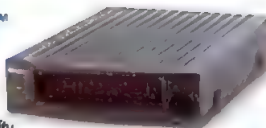
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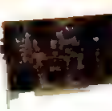
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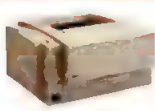
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LBP-460 4ppm 600dpi	384	374
LBP 1260 12ppm 600dpi	1279	1269
MultiPass 1000 Multi-function	724	709

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Optria RX 16ppm 1200dpi	2000	1980
Wimwriter 150C Inkjet 300dpi	359	349
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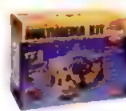
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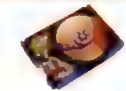
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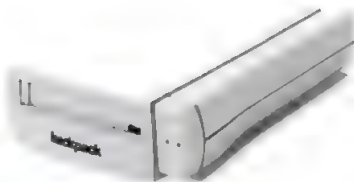
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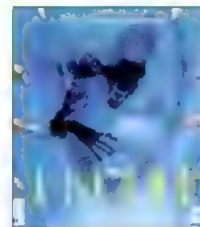
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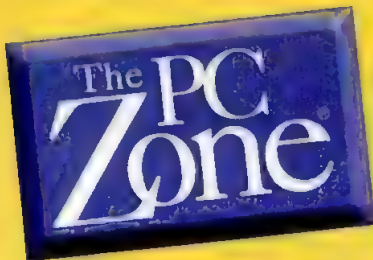
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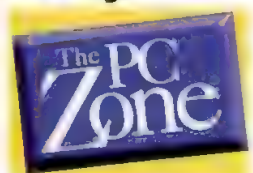


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NED FLAHERTY, Boston, Massachusetts

PC MAGAZINE: Your computer and other electronic equipment are indeed at risk from surges on telephone lines. A bolt of lightning—even if it doesn't hit the telephone wire directly—can induce powerful currents that wreak havoc on your electronics.

The good news is that you can protect your equipment against damage from phone-line spikes. Most major surge-suppressor manufacturers offer suitable devices, with prices that start at about \$25. You can choose from dedicated devices that protect only one or two phone lines, as well as AC power strips that include phone line connectors.

For even better security, consider installing a gas-discharge protector at the point where the phone line enters your home or office; this may be easier and more effective than adding suppressors for each piece of equipment. Contact a professional telephone-system installer in your area for more information on this type of protection.

Keep in mind as well that any long run of cable creates the risk of induced current, especially if the cable runs outdoors for any distance (between buildings, for example). If your network or serial connections do have long cable runs, you may want to ask a professional cable installer to make certain that the cables are properly grounded and that you have adequate protection against damaging surges.—Alfred Poor

OPERATING ENVIRONMENTS

Reclaiming Disk Space In OS/2



I recently ran out of space in my OS/2 boot partition, a surprising event since I keep all my programs and data in a different partition. The root directory of my OS/2 boot drive contains several "desktop" directories that seem to contain nothing but other, empty directories, yet somehow I've run out of space. Since I use only one desktop, can I get rid of the others? Will that let me regain some of the lost space?

KAREN SIMON, Bethesda, Maryland

PC MAGAZINE: One of the reasons OS/2 is described as robust is that it can often detect and recover from problems the user doesn't even know about. A problem that might otherwise force you to shut down and restart the system is taken care of automatically. You may have noticed an occasion when the desktop icons disappeared for a few seconds and then reappeared. Chances are, OS/2 brought the Workplace Shell down for a moment to

correct a problem and then restarted it.

During the recovery process, OS/2 may need to re-create your desktop directory on disk with fresh, uncorrupted information, using additional space. After a few months, you may end up with multiple versions of the desktop in your OS/2 partition's root directory. If you examine one of the desktop directories (named DESKTOP, DESKTOP1, DESKTOP2, and so forth), you'll see that it contains a subdirectory for each folder on the desktop. But, if all these directories are empty, why do they take up space?

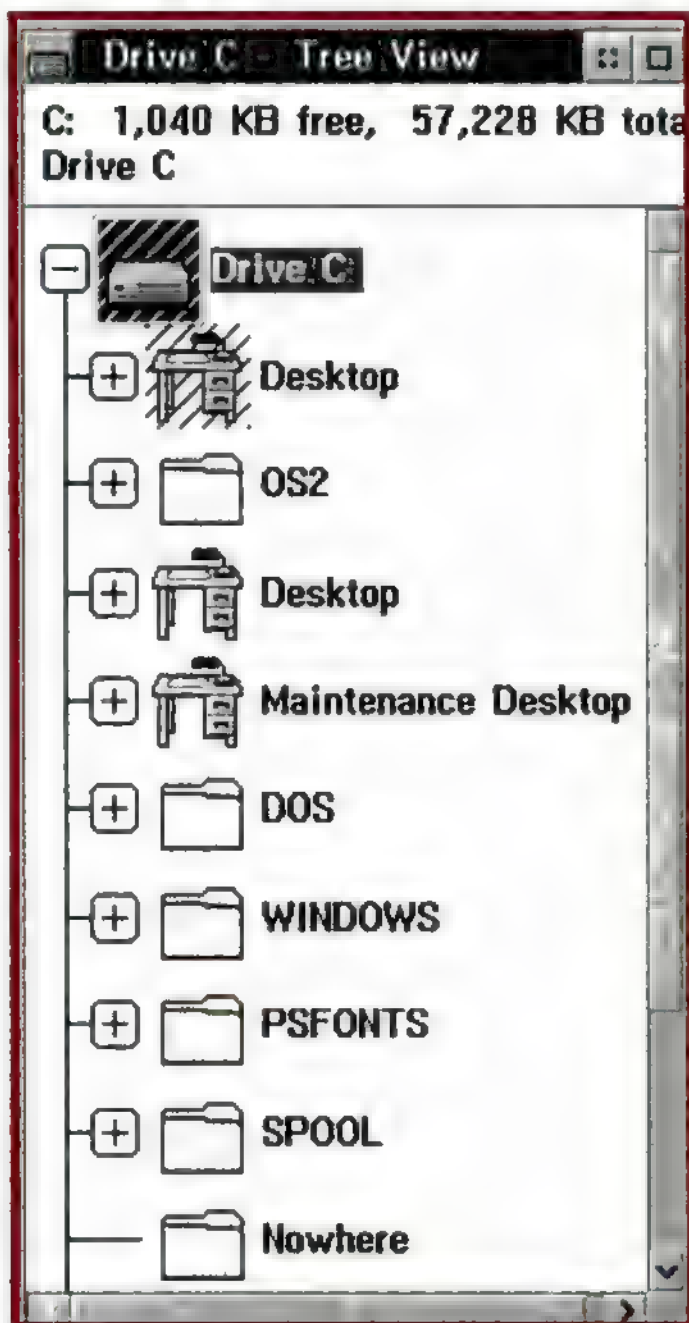


FIGURE 1: The crosshatched desktop is the active one; you can delete any other desktops.

Each folder subdirectory has extended attributes attached to it that define both the objects that appear within the directory and the attributes of those objects. The desktop directory has extended attributes describing the desktop and any objects on the desktop that aren't folders. That can add up to a lot of space: Depending on the number of folders you've created and how full they are, each desktop directory can range in size from around 150K to half a megabyte or more.

The first step in recovering that space is determining which of the desktop directories is the one currently being used. The easiest technique is to open the Drives object that represents the OS/2 boot partition, as shown in Figure 1. In this tree view, the active desktop is the one highlighted with gray crosshatches, indicating

that it's open. The desktop two lines down is an old one and can be deleted.

If you're lucky, deleting can be as easy as dragging the item onto the shredder. In most cases, though, OS/2 has assigned the folder an attribute that prevents the shredder from deleting it. This is a special attribute, not one of the standard Read-Only, Archive, Hidden, or System attributes, so you can't clear it manually. If you open the folder's pop-up menu by clicking on it with mouse button 2, you won't see a Delete entry in the menu. The only method that works reliably is to go to a command prompt and navigate through each individual subdirectory, deleting all files and removing the subdirectories with the RD command. Once you've worked your way through all the subdirectories, you should be able to remove the desktop directory itself.—Brian Proffit

Color Me Blue

Launching DOS applications under Windows sometimes causes odd color changes. For example, the DOS editor's default blue background changes to red. Is there anything I can do to prevent this, or must I just accept it as part of the cost of running DOS apps under Windows?

MATT McLAUGHLIN, via the Internet

PC MAGAZINE: Chances are very good that you don't have to put up with weird color changes caused by loading DOS applications. This problem, and a similar one in which colors in Windows are bizarre after return from a full-screen DOS box, can often be traced back to the driver for your video card. Contact the maker of the video card to see if you can get a newer set of drivers, or check out your favorite on-line service, which may have new drivers available. On CompuServe, for example, Library 4 in the MSWIN forums is devoted to display drivers. Once you acquire and install the new drivers, your blues should stay blue.—Neil J. Rubenking

Dealing with a Vestigial Program Reference

I recently deleted Quicken for Windows from my system, and now every time I start Windows I get the message "Cannot find file C:\quickenw\BILLMND.EXE specified in WIN.INI (or one of its components). Check to ensure the path and filename are correct and that all required libraries are available."

I don't like messing around with these files if I'm not exactly sure what I'm doing, so how can I get that message to stop appearing?

SCOTT BOWDEN, Hanson, Massachusetts



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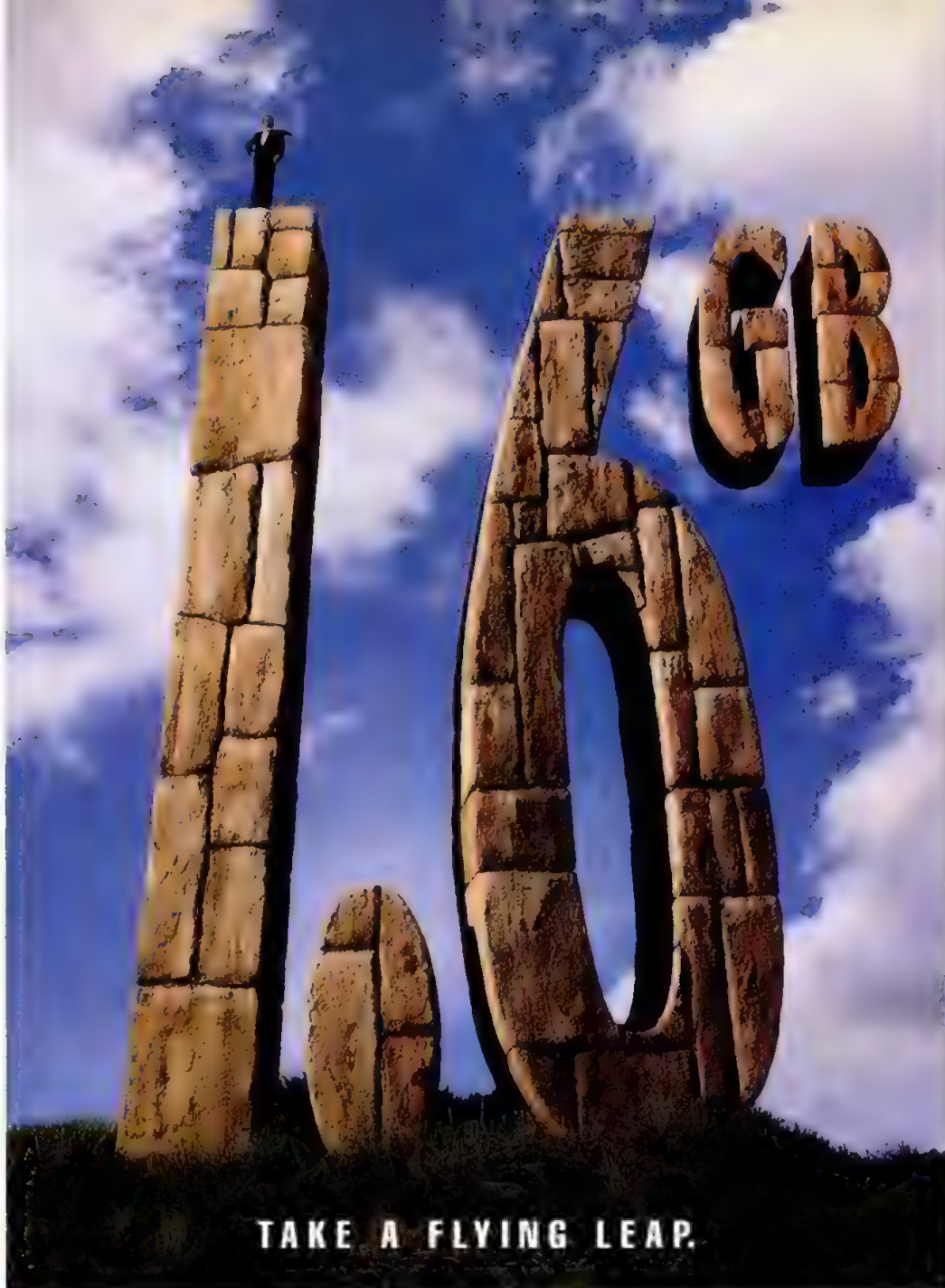
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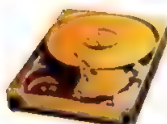
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PC MAGAZINE: It's easy enough to delete all files in a program's directory and to remove its program group or program item from Program Manager. Clearly you've managed those steps without trouble. The message you're getting indicates that Quicken added its Bill Minder program to the load= or run= line in WIN.INI. To get rid of the message, whether it refers to a Quicken utility or another missing-in-action program, you simply get rid of the reference in WIN.INI.

Load WIN.INI into Notepad (or your favorite text editor) and locate the section that begins with the heading [windows]—it's usually the first section. Below that heading, look for lines beginning with load= and run=. You should find the Bill Minder filename on one of these lines. If it's the only filename on the line, simply delete everything after the equal sign. If there are other filenames on the line, be careful to delete only the Bill Minder filename. That should put an end to your error message.

—Neil J. Rubenking

WORD PROCESSING

Adding Sound to Macros and Commands in Word 6



If you've got a sound card or PC speaker driver installed in Windows 3.1, Word makes it easy to embed sounds in a document using OLE. But a much more useful possibility is to add sounds to commands and macros.

To play sound via a macro, you need add only two commands. The first, which goes before the Sub MAIN statement, is a Declare statement:

```
Declare Function sndPlaySound Lib
  "mmsystem.dll" (lpzsoundname$,
  wflags As Integer) As Integer
```

The second command, which actually plays the sound, is:

```
x = sndPlaySound("DRIVE:
  Path\Filename", wflags)
```

This line goes anywhere in the macro where you want the sound played. If you're opening a dialog box, for example, you might play a .WAV file just before opening the dialog box or just after closing it. Or you might play a .WAV file after some operation in a macro, as a way to report progress.

You can use the same two statements to add sound to a built-in command by creating a macro with the same name as the command. First, find the command by choosing Tools |

Macro, setting the Macros Available In: box to Word Commands, and then scrolling through the list of commands to highlight the one you want. Then, with the command entered in the Macro Name text box, reset the Macros Available In: box to All Active Templates and choose Create. Word will open a macro-editing window that typically consists of the Sub MAIN and End Sub statements plus the Word command. For the FileSave command, for example, the macro will read:

```
Sub MAIN
FileSave
End Sub
```

Simply edit the macro to add the two statements shown above and save it. Unless you erase this macro, Word will substitute it for the built-in command of the same name whenever you give that command.

MARSCHELL D. RAY, Wallkill, New York

PC MAGAZINE: This technique for playing sounds in Word 6.x works not only in Windows 3.1 but in Windows for Workgroups 3.11 and Windows 95 as well. It will also work with Word 95, with a slight modification. Before we look at the Word 95 version, though, it's worth taking a closer look at the statements for the sake of those who have never used a Declare statement before.

The Declare statement in WordBasic lets you use a routine stored in either a Windows dynamic link library (DLL) or a Word add-in library (better known as a WLL). The hard part is learning what routines are available, which files they're stored in, what the arguments are for each routine, and what type of data the routine returns.

In this particular case, the Declare statement tells WordBasic that there's a routine called sndPlaySound in the library file MM-SYSTEM.DLL and that the function returns an Integer. If you like, you can identify the file simply as "mmsystem" rather than "mmsystem.dll" and WordBasic will still be able to find it, since the program assumes a .DLL extension unless told otherwise. The statement would then read:

```
Declare Function sndPlaySound Lib
  "mmsystem" (lpzsoundname$,
  wflags As Integer) As Integer
```

Having identified the sndPlaySound routine in the Declare statement, you can then use the sndPlaySound routine to play the .WAV file sounds as many times as you like within the macro, using the line:

```
x = sndPlaySound("DRIVE:Path\
  Filename", wflags)
```

If you try running this macro in Word 95,

however, you'll get the error message "Unable to load specified library." That's because Word 95 is a 32-bit program and won't work with 16-bit libraries. The solution is to use the equivalent 32-bit library file instead, which happens to be WINMM.DLL. (There's no easy way to know this. You just have to ask whoever is responsible for any given 16-bit DLL what the equivalent 32-bit file is called.)

The 32-bit version also uses a different name—PlaySound—for the equivalent function and, according to Microsoft, it changes the Type for the wFlags parameter and the value returned from Integer to Long. The Declare statement thus becomes:

```
Declare Function PlaySound Lib
  "winmm" (lpzsoundname$,
  wflags As Long) As Long
```

And the command for actually playing an audio file becomes:

```
x = PlaySound("DRIVE:Path\Filename", 0)
```

There are couple of oddities about these statements that you should note. First, the Declare function in Word 95 works just as well if you identify the type as Integer instead of Long in both places it shows up. But don't do it! This is a fluke that you can't rely on.

Second, the command for playing the sound in both Word and Word 95 works just as well if you omit the x and the equal sign. According to Microsoft, the statements

```
sndPlaySound("DRIVE:Path\Filename", 0)
```

and

```
PlaySound("DRIVE:Path\Filename", 0)
```

shouldn't work. But, in fact, they do. I mention these oddities only because you may accidentally discover them on your own. The best advice is: Don't use the incorrect form, even though it works. If Microsoft ever changes WordBasic to match the documentation, you'll have to fix your macros.

—M. David Stone

SPREADSHEETS

Precision vs. Accuracy



When I converted some of my old DOS spreadsheet files into Excel 5.0, several calculations did not yield the same results. In particular, certain formulas using the IF function returned one value in my DOS spreadsheet and a different value in Excel. Here's an example:

Cell A4 contains the number 27.05 and cell

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```

*****
' IsDir (strDir As String)           Access 2.0
' Return True (-1) if strDir is a directory that exists.
' False (0) otherwise
*****

Function IsDir(strDir As String)
    Dim strSavedDir As String
    Dim strChDrive As String, n As Integer

    IsDir = True           ' Initialize to True
    On Error GoTo IsDirErr ' Set up error handler

    n = InStr(strDir, ":") ' Was drive letter specified?
    If n <> 0 Then          ' If so, save the curdir on
                            ' that drive
        strChDrive = Mid$(strDir, n - 1, 1)
        strSavedDir = CurDir(strChDrive)
    Else
        strSavedDir = CurDir
    End If

    ' Attempt to change to the directory
    ChDir strDir           ' If this doesn't work, IsDirErr
                            ' is called
    ChDir strSavedDir       ' Restore saved curdir

IsDirExit:
    Exit Function

IsDirErr:
    IsDir = False          ' Directory does not exist
    Resume IsDirExit

End Function

```



FIGURE 2: You can use the IsDir function in your Access programs to check whether a directory exists.

B4 contains 26.10. In cell C4, I use the formula =A4-B4 to calculate the difference between these two values; the result is 0.95. In D4, I enter 0.95 again, this time as a constant. E4 contains the formula =IF(C4=D4,1,0). The formula returns 1 in my DOS spreadsheet, but 0 in Excel!

Microsoft's tech support insists that the problem is related to the way computers handle numbers and that it's unavoidable, but I find that hard to believe. What do you say?

ROLAND W. MADDREY, JR.,
Raleigh, North Carolina

PC MAGAZINE: This kind of problem, which has plagued spreadsheet users since VisiCalc, occurs because your computer is more precise but less accurate than you'd like it to be. The results of calculations such as A4-B4 are stored in memory to some large number of decimal places—15, in the case of Excel. Unfortunately, though, while 26.10 subtracted from 27.05 is exactly 0.95, Excel records the result as 0.949999999999999. And, unless you've requested a display format that gives you many decimal places of precision, you aren't likely to notice that the result of your calculation is a hair less than you'd expect.

As Microsoft indicated, the inaccuracy has to do with the way your computer handles numbers. More specifically, it has to do with the fact that certain decimal numbers cannot be represented as exactly equivalent binary numbers and vice versa. In the translation between binary and decimal, some detail at the umpteenth decimal place occasionally gets lost. Meanwhile, the IF function, being both precise and stupid, sees that 0.949999999999999 is not equal to 0.95, and you end up with an inaccurate result.

To work around the problem, you can write

your IF formula in either of the following ways:

```

=IF(ABS(C4-D4)<.0001,1,0)
=IF(ROUND(C4,4)=ROUND(D4,4),1,0)

```

The first formula adjusts the IF test to see whether the absolute value of the difference between your two values is less than some small threshold amount. The second approach rounds the two values, C4 and D4, before comparing them. Both formulas reduce the precision of the IF function, preventing meaningless discrepancies between compared values from disturbing the logic of your model.

Since you may well want to move your spreadsheet files from one program to another or share your models with someone working in a different operating environment, it's a very good idea to qualify your IF formulas with constructions of this sort. Anomalies that don't show up until your model lands in a new environment can create serious havoc.

—Craig Stinson

DATABASES

IsDir for Microsoft Access



You recently published an IsDir function for FoxPro that checks to see if a directory exists on a particular drive. Is there a similar function for Microsoft Access?

TED MESSINGER,
Palo Alto, California

PC MAGAZINE: Sure. You can use the IsDir function shown in Figure 2 in your Access Basic routines to check for the existence of a

directory. It starts by saving the current directory on the drive in question and then attempts to change to the directory you're checking for. If an error occurs, the directory does not exist and IsDir will return False. If an error doesn't occur, then IsDir will return True, indicating that the directory exists. Before returning, IsDir changes back to the directory current before the function was called.

The string you pass to the IsDir function can contain a drive specification, but it doesn't have to. If you do include the drive, IsDir saves and restores the current directory on that drive. Otherwise IsDir saves the current directory on the default drive.

You can download the IsDir function from PC Magazine Online. See the sidebar "Shareware and Utilities" that appears on the last page of this issue's Special Report. Look for the file named ISDIR.AB.—Sal Ricciardi

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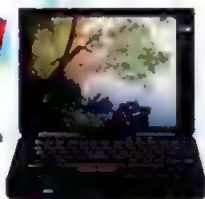
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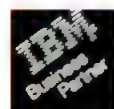


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M53	Pentium® 100MHz	8/1GB	Mini Tower	IBA2168M53	2,299
M61	Pentium® 120MHz	8/1.6GB	Mini Tower	IBA2168M61	2,399
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1080MB	10.5ms	3.5" .75"H	Seagate	5,400	128	ST51080A	239	289*
1090MB	12ms	3.5" 1"H	Fujitsu	4,500	64	FJ1614A	209	259*
850MB	10ms	3.5" 1"H	Western Digital	4,500	64	WD2850A	199	249*
1620MB	9ms	3.5" 1"H	Western Digital	5,200	128	WS31600A	349	399*
SCSI								
1080MB	10ms	3.5" 1"H	Fujitsu	5,400	256	FJ1606S	\$285	\$385
2100MB	8.9ms	3.5" HH	Fujitsu	7,200	512	FJ2915S	725	825
2174MB	8ms	3.5" 1"H	Seagate	7,200	512	ST32550W	1,019	N/A
4294MB	9ms	3.5" HH	Seagate	5,411	512	ST15230N	1,079	1,179
4200MB	8.9ms	3.5" HH	Fujitsu	7,200	512	FJ2934W	1,089	N/A
9100MB	12ms	5.25" FH	Micropolis	5,400	512	MC1991AV	2,225	2,325

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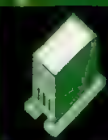


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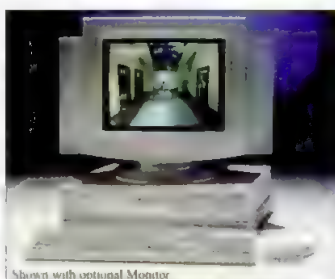
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Force 484	Pentium® 75MHz	8/1.2GB	Desktop 2000	PBF484	1,929
Force 487	Pentium® 75MHz	16/1.2GB	Mini-Tower	PBF487	1,999
Spectria 310	Pentium® 75MHz	8/850MB	All-In-One	PBSB310	1,929
Force 860	Pentium® 100MHz	8/850MB	Desktop	PBF860	1,799
Force 872	Pentium® 100MHz	16/1.6GB	Mini-Tower	PBF872	2,399
Force 998	Pentium® 133MHz	16/1.6GB	Tower 4000	PBF998	2,649
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486DX4/100E	8/850MB w/CD	Mid-Tower	ITV100E88C	1,299
486DX4/100E	8/1.2GB MM	Mid-Tower	ITV100E81M	1,499
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IBM ThinkPad 701C



340MB HDD
\$3609

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• Active Color
• 10.4 Display
• 8M RAM
• Keyboard: AC Adapter
• TrackPoint II
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Corel DRAW! 5.0 CD Upgrade 442/234	
Microsoft Windows 95 Upgrade	89
Microsoft Windows 95 3.5" CD	179/89
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Microsoft Office Pro Upgrade	539/215
Microsoft Office Pro w/Bookshelf	539
Microsoft Office Pro w/Bookshelf Upgrade	315
Microsoft Office 95 Full Upgrade	447/222
Microsoft Word 95 Upgrade 3.5"	39
Microsoft Word 95 Upgrade 3.5" CD	134
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Apple

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Ascenta 900N 910N

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COMPAG

Contura 400CX 410CX

Contura 400CX 410CX

HEWLETT PACKARD

LaserJet 4P 4MB, 4V, 5P, SMP

LaserJet 4P 4MB, 4V, 5P, SMP

LaserJet 4S 4MB, 4V, 5P, SMP

LaserJet 4S 4MB, 4V, 5P, SMP

TOSHIBA

T2100, 2105, 2110, 2130

2105, 2110

4MB \$195

8MB \$369

16MB \$723

ThinkPad 701C CS

ThinkPad 755

ThinkPad 755

T2400 CS, CT, T3400

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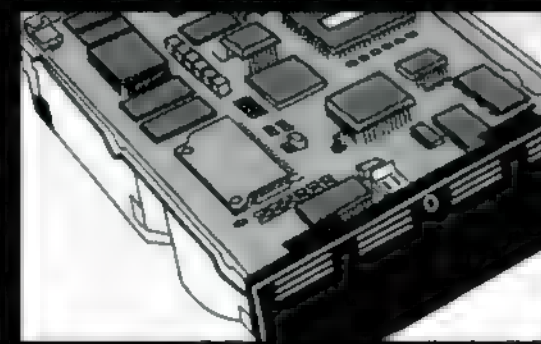
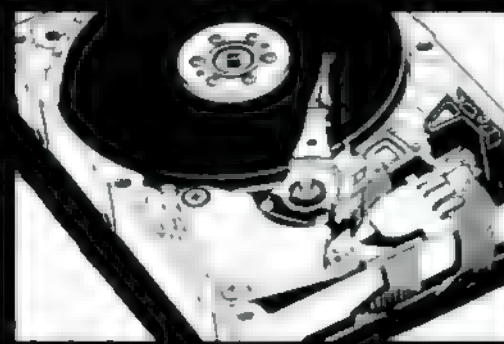
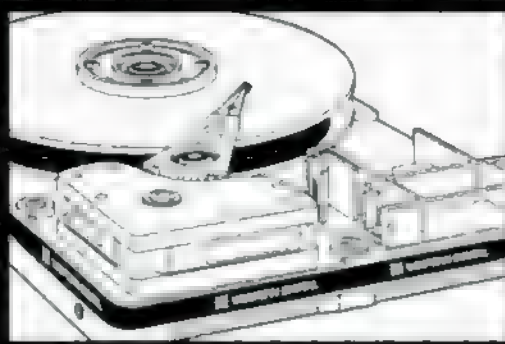
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The Drive Authority!



UNEQUALED REPUTATION

Nobody knows drives like MegaHaus. We have specialized in storage solutions for over 8 years. Repeat business from satisfied customers is the backbone of our business. We satisfy our customers.

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During the first year of your warranty, we replace, not repair, any defective items. All items receive lifetime technical support from our factory trained techs.

SAME DAY SHIPPING

Our multi-million dollar inventory offers you the best diversity and availability in the market. We ship most orders the same day. Each order is checked at least four times for accuracy.

FAST, EASY INSTALLATION

Anyone can sell a hard drive to you. We sell easy to install storage solutions. We spend countless hours researching the best solutions, then create our quick precise installation guides for each kit.

UNBEATABLE DEALS

NEC				
IDE	1620MB	3yr	4500rpm	NEC3747 \$349
SCSI	1050MB	3yr	4090rpm	NEC3827 \$255
	1620MB	3yr	4500rpm	NEC3847 \$379



SyQuest

Compare SyQuest removable cartridge drives to ZIP.

135MB IDE \$189
270MB IDE \$349
Includes 1 FREE cartridge

Twice the performance!
Twice the warranty!
Metal construction!
Hard drive technology!

FUJITSU

Every customer who purchases a Fujitsu hard drive from MegaHaus between 11/15/95 & 12/15/95 is entered in a drawing for 1 Fujitsu 4Gig drive.

IDE				
	540MB	3yr	5400rpm	M1603T \$169
	1080MB	3yr	5400rpm	M1606T \$215
SCSI				
	540MB	3yr	5400rpm	M1603S \$180
	1080MB	3yr	5400rpm	M1606S \$289
	2176MB	5yr	7200rpm	M2915S \$659
	4350MB	5yr	7200rpm	M2934S \$959
WIDE SCSI				
	2176MB	5yr	7200rpm	M2915W \$699
	4350MB	5yr	7200rpm	M2934W \$1025

PINNACLE MICRO RECORDABLE CD ROM

PC Internal (w/ controller, software, 2 disks)	\$1199
PC or Mac External (w/ controller, software, 2 disks)	\$1399
4.6Gig OPTICAL DRIVE	
PC Internal (w/ controller, software, 1 disk)	\$1499
PC or Mac External (w/ controller, software, 1 disk)	\$1499

MEDIA SALE!	Qty 4	10	25	50	100
230MB Optical	\$23	\$19	\$17	\$16	\$15
1.3Gig Optical	\$61	\$59	\$56	\$55	\$54
CD-R-74	\$9	\$7.68	\$6.78	\$6.58	\$6.28
SyQuest 270MB	\$59	\$56	\$54	\$53	\$52

HARD DRIVES

HARD DRIVES

CD ROM DRIVES

CONTROLLER CARDS

CONNER			
IDE	850MB	14ms	CFS850A \$195
	1278MB	14ms	CFS1275A \$255
SCSI			
	1080MB	11ms	CFP1080S \$289
	2147MB	8.5ms	CFP2105S \$679
	2147MB	9ms	CFP2107S \$719
	4294MB	8.5ms	CFP4207S \$1049

MICROPOLIS

SCSI			
	2050MB	8.5ms	MC4221 \$779
	4294MB	8ms	MC3243 \$1045
	9100MB	12ms	MC1991 \$1999
WIDE SCSI			
	2050MB	8.5ms	MC4221W \$899
	4294MB	8ms	MC3243W \$1169
	9100MB	12ms	MC1991W \$2139
SCSI-AV Audio / Visual tuned drives			
	2000MB	8.5ms	MC4221AV \$835
	4294MB	8ms	MC3243AV \$1129
	9100MB	12ms	MC1991AV \$2139
WIDE-AV Audio / Visual tuned drives			
	2000MB	8.5ms	MC4221WAV \$929
	4294MB	8ms	MC3243WAV \$1229
	9100MB	12ms	MC1991WAV \$2219

Seagate

IDE			
	545MB	14ms	ST3660A \$175
	850MB	11ms	ST5850A \$195
	1083MB	12ms	ST31220A \$235
	1083MB	11ms	ST51080A \$240
SCSI			
	1052MB	9ms	ST31230N \$375
	2147MB	9ms	ST32430N \$735
	2147MB	8ms	ST32550N \$859
	4290MB	9ms	ST15230N \$965
	4290MB	8ms	ST15150N \$1239
	9080MB	11ms	ST410800N \$2099
WIDE SCSI			
	2147MB	8ms	ST32550W \$969
	4290MB	8ms	ST15150W \$1339

Quantum			
IDE	850MB	12ms	TB850A \$195
	1050MB	12ms	FB1080A \$229
	1280MB	12ms	FB1280A \$248
SCSI			
	540MB	12ms	FB540S \$185
	850MB	14ms	TB850S \$239
	1050MB	12ms	FB1080S \$295
	2150MB	8ms	XP32151 \$789
	2216MB	8.5ms	VP32210 \$692
	4300MB	8.6ms	XP34301 \$979

WESTERN DIGITAL

IDE			
	635MB	11ms	AC2635 \$175
	850MB	10ms	AC2850 \$195
	1280MB	10ms	AC31200 \$280
	1620MB	9ms	AC31600 \$379

Maxtor

IDE	427MB	12ms	M7425AV \$149
	540MB	12ms	M7540AV \$179
	854MB	12ms	M7850AV \$195
	1.2Gig	12ms	M71260A \$272
	1.6Gig	12ms	M71626AP \$369

SYQUEST

The #1 name in removable media drives! All drive prices include 1 FREE disk!

SCSI	135MB	200MB	270MB
Internal	n/a	\$422	\$399
External	\$239	\$482	\$429

IDE

Internal	\$189	n/a	\$349
Parallel Ext	Call	n/a	\$489

Genuine SyQuest Cartridges

Qty 2-4 / 5-9 / 10+ or with drive

44MB	\$53/51/49	88MB	\$55/51/49
105MB	\$56/54/53	135MB	\$23/21/19
200MB	\$80/75/72	270MB	\$65/62/59

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SCSI				
Sanyo	SH254S	4X	190ms	\$179
NEC	CDR4X	4X	220ms	\$229
Pioneer	DRU124X	4.4X	140ms	\$245
Toshiba	XM3601	4.4X	155ms	\$309
Plextor	PX43CE	4.5X	130ms	\$329
NEC	CDR6X	6X	150ms	\$349
Toshiba	XM3701	6.7X	120ms	\$369
Plextor	6PLEX	6X	145ms	\$459
IDE (ATAPI)				
Toshiba	XM5302A	4X	190ms	\$159
Teac	CD56E	6X	110ms	\$259
NEW		8X		\$359
CD ROM CHANGERS				
Nakamichi	7Disc	2X	380ms	\$259
Nakamichi	7Disc	4X	340ms	\$429
Pioneer	6Disc	4.4X	190ms	\$509
Pioneer	18Disc	4.4X	300ms	\$1899

CD ROM TOWERS

Seven drives in a single enclosure.
Sanyo 4X \$1629 NEC 4X \$2129
Toshiba 6.7X \$3229 NEC 6X \$3079
1-21 drive models & other mechanisms available.

TAPE DRIVES

Save \$10 on tape drive with hard drive purchase! All prices include 1 FREE TAPE, cable, software.

CONNER	Int	Ext	COLORADO	Int	Ext
420MB	\$145	\$295	350MB	\$149	\$259
800MB	\$189	\$305	800MB	\$199	\$345
1.7Gig	\$249	n/a	1360MB	\$269	n/a

-SCSI Kit includes 16bit card, DOS or Windows software & 1 tape.

	Bare	Kit
525MB Conner	2525	\$479
2Gig HP	C1534A	\$699
2Gig Conner	C4320RT	\$789
2-4Gig Tandberg	3700	\$439
2-4Gig Conner	TSM4000	\$515
2-4Gig Conner	C4324RP	\$849
2-4Gig HP	C1536A	\$799
4-8Gig Conner	C4326NP	\$929
4-8Gig HP	C1533A	\$1029
3-7Gig Exabyte	8205XL	\$1259
7-14Gig Exabyte	8505XL	\$1879

We offer backup software for most computers and operating systems. TAPEBACK use our SCSI tapes as a regular disk drive. NOW ONLY \$199

OPTICAL DRIVES

Fujitsu	230MB External for parallel port	\$439
	230MB External SCSI	\$479
NEC	1.3 Gig with 1 disk	\$1069

DRIVE HARDWARE



High Quality pull out brackets for 3.5" hard drives. Mounts in 5 1/4" bay. Entire frame is metal, gold connectors rated at 50K insertions, built in cooling fan. SCSI unit has ID select on cartridge. Great for security, RAID, or Backup. Hot swappable!

SCSI	1 \$85	2-9 \$82	10+ or w/ drive	\$79
IDE	1 \$79	2-9 \$76	10+ or w/ drive	\$73

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HARD DRIVES
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Dickinson, Texas 77539

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HP OmniBook 5000 Notebook PC

HP OmniBook 600

- Weighs **ONLY 3.8 pounds!**
- Built-in 16-bit sound, microphone & speaker
- Built-in infrared for no-hassle printer connections
- Instant "ON" ready-to-work state — lasts for months on a charge

Processor	Screen	RAM	Price
186DX4/75	8.5" Dual Scan	340MB	\$2539
186DX4/75	9.5" Active	340MB	2999

HP OmniBook 5000

- Pentium 90MHz with 32-bit PCI Local bus
- 1.2GB drives available for high capacity storage
- High resolution — 800x600 resolution on notebook display
- Built-in 16-bit sound, microphone & speaker

Processor	Screen	RAM	Price
Pentium 90	10.4" Active	1.2GB	\$5579
Pentium 90	10.4" Active	1.2GB	6239*

*16MB RAM standard

Other Products from Hewlett-Packard



HP DeskJet 340

HP LaserJet Printers

HP LaserJet 5P printer (IBM, 6ppm, 600dpi) ...\$879.99
HP LaserJet 4P printer (IBM, 4ppm, 600dpi) ...\$479.00

HP InkJet Printers

HP DeskJet 600C printer ...\$289.99
HP DeskJet 600C printer ...289.99
HP DeskJet 600C printer ...299.00
HP DeskJet 660C printer ...389.99
HP DeskJet 660C printer ...399.00
HP DeskJet 855C printer ...\$49.00
HP DeskJet 1600C printer ...1349.99

Home Office Products

HP OfficeJet ...\$599.99
HP OfficeJet LX ...689.99
HP FAX-700 ...\$49.99

HP Scanners

HP ScanJet 4C (color) ...\$369.99
HP ScanJet 4C (color) ...\$49.99

HP (Colorado) Tape Drives

Trekker 350MB (portable) ...\$219.99
Jumbo 350MB (internal) ...119.99
Jumbo 1400, 1.36GB (internal) ...229.99
T1000, 800MB (internal) ...179.99
T1000e 800MB (portable) ...299.99

NEC

All NEW Models
Optimized for
Windows 95

WIN95
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Great Holiday Value!
NEC Ready
Multimedia

Ready Multimedia (4X CD-ROM) NEW for Windows 95

- Quad Speed CD-ROM drive
- 16-bit, 3-D surround sound system
- 28.8 fax/modem, full duplex speaker phone & answering machine
- Super fast 64-bit PCI local bus graphics
- Built-in MPEG support for full screen, full motion video
- 32-bit PCI IDE controller — fast disk performance
- LOADS of **FREE** software

Classic	Processor	RAM	Price
Minitower	Pentium 75	1GB	\$1899
Minitower	Pentium 100	1GB	2299
Minitower	Pentium 100	1.6GB	2699
Minitower	Pentium 120	1.6GB	2999
Minitower	Pentium 133	1.6GB	3299

Monitors priced separately

WIN95
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Versa 2000



Versa 4000

NEC Versa 4000

- Built-in CD-ROM drive! (Standard on some models, optional on others)
- Pentium 75 and Pentium 100 processors
- 256KB Level 2 cache to optimize performance
- Incredible displays — 65k color Dual Scan, 16 million color Active-Matrix displays available — 800x600 res.
- Built-in 16-bit sound, microphone, MIDI and 2 built-in speakers
- Multimedia docking station with outstanding Alice Lansing speakers (optional, priced separately)

Processor	Screen	RAM	Price
Pentium 75	10.4" Dual Scan	540MB	\$3499
Pentium 75	10.4" Dual Scan	540MB	3799*
Pentium 75	10.1" Active	540MB	3999
Pentium 90	10.1" Active	810MB	4649*
Pentium 90	10.4" High Res.	810MB	4799

*Features built-in CD-ROM drive standard

Versa 2000

- Lithium ion battery technology
- Versatile touch-pad pointer — simple & accurate
- Built-in, upgradeable 14.4 fax/modem (on selected models)
- LOADS of **FREE** software preinstalled

Processor	Screen	RAM	Price
486DX4/75	9.5" Active	350MB	\$2299*
486DX4/75	9.5" Active	350MB	2599
486DX4/75	9.5" Active	540MB	2799

*14.4 fax/modem not built-in

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✓ Free Tech
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✓ Free Software
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BIG!
11.3"
Screens

Great Holiday Value!

120MHz
Pentium
with PCI bus

WIN95
INSTALLED

Tosca 700



- PCI bus architecture (internal & external)
- 11.3" 800x600 high resolution display
- Optional 4X CD-ROM Drive (swap floppy & CD-ROM)
- Multimedia docking station with PCI bus
- Built-in 16-bit sound, microphone, 2 speakers & MIDI
- HUGE 1.26GB hard drives

Pentium 120 11.3" Dual Scan 1.26GB CALL
Pentium 120 11.3" Active 1.26GB CALL

90MHz
Pentium

WIN95
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Portégé 610CT

Satellite Pro 400 & Satellite Pro 410

- Built-in 4X CD-ROM Drive (Swap floppy & CD-ROM)
- On-line model color (optional Dual Scan)
- Built-in 16-bit sound, microphone, speaker & MIDI
- 6400K RAM memory expansion (64MB, 128MB, 256MB)
- Built-in 4X adapter, small, sleek design & reduced weight
- Integrated Accupoint, small, accurate & easy to use
- Lithium Ion battery technology
- Built-in infrared for wireless communications

Satellite Pro 400

Pentium 75 10.4" Dual Scan 772MB \$3539
Pentium 75 10.4" Active 772MB 4359

Satellite Pro 410

Pentium 90 11.3" Dual Scan 772MB CALL
Pentium 90 11.3" Active 772MB CALL

Portégé 610CT

- Pentium 90MHz processor
- 9.5" True Color display for optimum color
- Built-in 16-bit sound (SoundBlaster Pro compatible), microphone & speaker
- Lithium Ion battery technology
- Accupoint stick for easy control

Pentium 90MHz 9.5" True Color 720MB \$4359



Satellite Pro 400

Satellite 2110/2130

486DX4/75 10.4" Dual Scan 330MB \$1979
486DX4/75 10.4" Dual Scan 500MB 2459
486DX4/75 10.4" Active 500MB 3059

IBM®

ThinkPad 701

- Amazing pop-up, full-sized keyboard w/ jigsaw design
- 10.4" Active & Dual Scan
- Only 4.5 lbs. in subnotebook form factor
- 14.4 fax modem, speaker phone, answering machine & voice mail
- Built-in 16-bit sound, microphone, speaker & MIDI
- Built-in infrared for no-hassle printer connections
- 20 FREE software titles preinstalled

486DX2/50	10.4" Active	360MB	\$2199
486DX2/50	10.4" Active	540MB	2399
486DX4/75	10.4" Dual Scan	360MB	2649
486DX4/75	10.4" Dual Scan	540MB	2949
486DX4/75	10.4" Active	360MB	3219
486DX4/75	10.4" Active	540MB	3499
486DX4/75	10.4" Dual Scan	720MB	3299
486DX4/75	10.4" Active	720MB	3879

Think Fast, Think Now, Think Savings!

Purchase before 12/31/95 and save up to \$650 on hardware and software additions to your ThinkPad. Call for details.

ThinkPad 755 Pentium Models Available.



ThinkPad 760

ThinkPad 760

- Pentium 90 & 120MHz with 32-bit local bus
- 12.1" Active displays with 800x600 resolution (selected models)
- 4X CD-ROM Drive, MPEG-2 support, & full motion video (ThinkPad 760C only *)
- Built-in 28.8 fax modem
- SoundBlaster-compatible audio & telephony
- Lithium Ion battery technology

Pentium 90	10.4" Active	720MB	\$5349
Pentium 90	12.1" Active	720MB	6049
Pentium 120	12.1" Active	720MB	6599
Pentium 90	12.1" Active	1.2GB	7449*

*Features built-in CD-ROM drive
WIN 95 models available. Call for details.



Active

Active Multimedia

- Quad Speed CD-ROM Drive
- 16-bit stereo sound - SoundBlaster Compatible
- Advanced Features - 28.8 fax modem, full duplex speaker phone, answering machine & voice mail
- 30 Watt stereo speakers
- Built-in MPEG support for full screen, full motion video
- Over 40 FREE software titles

Model	Pentium 75	1GB	\$1899
Model	Pentium 100	666B	2399
Model	Pentium 100	666B	2599*
Model	Pentium 120	666B	2599
Model	Pentium 133	666B	2999*

*16MB RAM standard
Monitors priced separately



ThinkPad 365C

ThinkPad 365

- Built-in CD-ROM Drive (on selected models only)
- Built-in audio, speaker, MIDI joystick port (available on all models except 365C5)
- 10.4" Active 666K colors & 10.4" Dual Scan
- Built-in infrared for no-hassle printer connection
- Loads of FREE software preinstalled

486DX4/75	10.4" Dual Scan	340MB	CALL*
486DX4/75	10.4" Dual Scan	540MB	CALL*
486DX4/75	10.4" Active	540MB	CALL*
486DX4/75	10.4" Dual Scan	540MB	CALL*
486DX4/75	10.4" Active	540MB	CALL*

*Features built-in CD-ROM drive
† Built-in audio, speaker, MIDI/joystick port not standard
WIN 95 models available. Call for details.

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LTE 5000



LTE 5000

- 50MHz or 100MHz Pentium power w/ 16MB & 256KB cache
- 3.2 bit PCI local bus graphics
- 8MB RAM exp. to 72MB
- Built-in 16-bit sound, microphone & 2 speakers
- MultiBay - holds CD-ROM, 2nd HDD, Floppy, or 2nd battery
- Up to 1.35GB hard drives (2.7GB max. capacity)
- Built-in infrared for wireless communications
- Supports NiMH & Lithium Ion batteries (up to 8 hrs.)
- Optional: MPEG and TV video adapter

Processor	Screen	RAM	Price
Pentium 75	10.4" Dual Scan	510MB	\$3799
Pentium 75	11.3" Dual Scan	810MB	4439
Pentium 75	10.4" Active	810MB	4729
Pentium 90	10.4" Active	810MB	5289
Pentium 90	10.4" Active	810MB	5549
Pentium 120	10.4" Active	1.35GB	6329

*Features Built-in CD-ROM drive



Contura 420/430

Product differs slightly from photo.

**WIN95
INSTALLED**

Contura 420/430

- 10.4" Active & Dual Scan
- Fast 486DX4-75 or 486DX4-100 processors
- Optical trackball - smoother & more reliable
- High capacity drives - up to 720MB
- Compaq 3-year worldwide warranty

Processor	Screen	RAM	Price
486DX4/75	10.4" Dual Scan	420MB	\$2459
486DX4/75	10.4" Active	420MB	3029
486DX4/100	10.4" Dual Scan	720MB	2839
486DX4/100	10.4" Active	720MB	3499

ProLinea

- Blazing Pentium speed - up to 133MHz Pentium
- BIGGER hard drives - up to 1GB
- PCI local bus - high-speed graphics
- PCI IDE controller - fast disk performance
- Multiple chassis sizes - get the expansion you need
- Compaq 3-year worldwide warranty w/ 1st year on-site

Chassis	Processor	RAM	Price
Desktop	486DX2/66	630MB	\$1289
Desktop	Pentium 75	630MB	1589
Desktop	Pentium 75	1GB	2069
Desktop	Pentium 90	630MB	1829
Desktop	Pentium 90	1GB	2319
Minitower	Pentium 75	630MB	1629
Minitower	Pentium 75	1GB	2129
Minitower	Pentium 100	1GB	2399
Minitower	Pentium 133	1GB	3139

Monitors priced separately

digital™

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**WIN95
INSTALLED**

Digital Starion

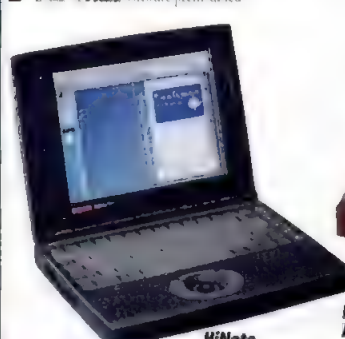
Digital Starion

NEW! Windows 95 Multimedia Computers

- Quad Speed CD-ROM Drive
- Pentium 133 - fastest Pentium available!
- PCI local bus - high speed graphics
- Unbelievable sound - SoundBlaster Pro-compatible, SW Wave table, Premium JBL speaker system
- Advanced Telephony - 14.4 fax/modem, 1-line duplex
- Speaker Phone & answer machine
- Lots of FREE software pre-installed

Chassis	Processor	RAM	Price
Minitower (910)	Pentium 75	850MB	\$1749
Minitower (915)	Pentium 100	850MB	1999
Minitower (920)	Pentium 75	1.2GB	2199
Minitower (930)	Pentium 100	1.2GB	2499
Minitower (940)	Pentium 133	1.2GB	2999

Monitors priced separately



HiNote



HiNote Ultra shown with
Mobile Multimedia Station

**WIN95
Upgrade Available**

HiNote

- All models 5.5 lbs or less - **ONLY 1.7" thick**
- Upgradable hard drive - get up to 510MB storage capacity
- Built-in front mounted trackball - easy to use for right- & left-handed users
- 3-year warranty - **FREE** 1-year Passport Service

Processor	Screen	RAM	Price
486DX2/50	9.5" Active	240MB	\$2239
486DX4/75	9.5" Dual Scan	510MB	2119
486DX4/75	9.5" Active	340MB	2259
486DX4/75	9.5" Active	510MB	2479

HiNote Ultra

- All models 4 lbs. or less - **ONLY 1.1" thick**
- Built-in sound, microphone & speaker
- Lithium Ion battery technology
- Built-in infrared
- 3-year warranty - **FREE** 1-year Passport Service
- **NEW Mobile Multimedia Option now available**

Processor	Screen	RAM	Price
486DX2/50	9.5" Dual Scan	340MB	\$2549
486DX2/50	9.5" Active	340MB	3079
486DX4/75	9.5" Dual Scan	528MB	3079
486DX4/75	9.5" Active	340MB	3319

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Advantage Adventure Desktop

Advantage Adventure Multimedia
(4X CD-ROM) NEW for Windows 95

- Quad Speed CD-ROM Drive
- Advanced Telephony - 14 for 28 Stay modem telephone answering system, and speaker phone (Differs by model, call for details)
- Integrated 4-speaker sound system
- Loads of **FREE** software pre-installed
- Windows 95 keyboard for increased productivity
- AST Works II navigation software - featuring SPOT
- Intel P6 OverDrive processor upgradable

Desktop (614)	Pentium 100	850MB	\$1889
Minitor (812)	Pentium 100	1.2GB	2089
Minitor (814)	Pentium 100	1.2GB	2379*
Minitor (818)	Pentium 133	1.6GB	2989*

Monitors priced separately *16MB RAM standard



75MHz
90MHz
Pentium

Ascentia 950N

- 90MHz Pentium - for blazing performance
- 10+ Active & Dual Scan
- High Res. displays - 800x600 res. on notebook
- Built-in 16-bit sound, microphone & speaker
- Lithium Ion battery technology
- Built-in infrared for no hassle printer connections

Pentium 75	10.4" Dual Scan	500MB	\$2639
Pentium 75	10.4" Dual Scan	800MB	2879
Pentium 75	10.4" Dual Scan	1.2GB	3249
Pentium 75	10.4" Active	800MB	3799
Pentium 75	10.4" Active	1.2GB	4199
Pentium 90	10.4" Dual Scan	800MB	3259
Pentium 90	10.4" Dual Scan	1.2GB	3639
Pentium 90	10.4" Active	800MB	4199
Pentium 90	10.4" Active	1.2GB	4579

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\$2449*

75MHz
Pentium
with PCI BUS



Extensa 550CD

Extensa 550/550CD

- 75MHz Pentium w/ PCI bus & 256KB cache
- Built-in 2X CD-ROM drive (optional on some models)
- Built-in 16-bit sound, microphone & speaker
- Integrated touchpad pointer
- 10+ Active Matrix & 10+ Dual Scan
- Built-in infrared for wireless communications

Pentium 75	10.4" Dual Scan	524MB	\$2449*
Pentium 75	10.4" Dual Scan	524MB	2939
Pentium 75	10.4" Active	524MB	3519

*CD-ROM Drive is an optional accessory on this model.

Extensa 450
as low as
\$1769

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Extensa 450

- 10+ Dual Scan & 9.5" Active display
- GlidePad pointing device
- Advanced battery pro
- Built-in infrared for no hassle printer connections

486DX4/75	10.4" Dual Scan	340MB	\$1769
486DX4/75	9.5" Active	340MB	2349



TravelMate 5000

TravelMate 5000/5100

- 75MHz or 90MHz Pentium with F1 Bus to optimize Pentium processor performance
- 10+ Active Matrix display with 2MB video RAM
- 10+ Dual Scan display with 2MB video RAM
- 65K colors on notebook display
- 16-bit Sound card, Speaker, Microphone & MIDI
- Upgradeable hard drive - easily add more storage
- Built-in dual lithium ion batteries
- Built-in infrared for no hassle printer connections

Pentium 75	10.4" Dual Scan	500MB	\$3479
Pentium 75	10.4" Active	772MB	3999
Pentium 90	10.4" Active	1.2GB	4799

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Minitor computers!

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- Two Top-Mounted Built-In Speakers
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- Choice of Windows® for Workgroups 3.11 or Microsoft® Windows 95
- Removable Lithium Ion Battery
- 2 PC Card Slots
- VersaGlide™ Pointing Device with Palm Rest

Model	Processor	Screen	HD/CD-ROM	Price
PC-6100-41402	Intel Pentium® 75MHz	10.1" DSTN	540MB	\$3,499
PC-6100-41402C	Pentium 75MHz	10.1" DSTN	540MB/2X	\$3,799
PC-6100-11402	Pentium 75MHz	10.1" TFT	540MB	\$3,999
PC-6100-11602C	Pentium 90MHz	10.1" TFT	810MB/2X	\$4,699
PC-6110-71602	Pentium 90MHz	10.4" Hi-Res TFT	810MB	\$4,799

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NEC Versa 2000

- 75MHz DX4 Processor
- Removable Lithium Ion Battery
- 2PC Card Slots
- VersaGlide Pointing Device with Palm Rest

Model	Screen	HD/Memory/Modem	Price
PC-6010-41301W	10.4" DSTN	350MB/4MB RAM	\$1,999
PC-6010-11301W	9.5" TFT	350MB/4MB RAM	\$2,299
PC-6010-11302MW	9.5" TFT	350MB/8MB RAM/14.4 Kbps	\$2,599
PC-6010-11402MW	9.5" TFT	540MB/8MB RAM/14.4 Kbps	\$2,799

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NEC MULTISPIN®: THE CUTTING EDGE IN CD-ROM READERS

Model	Data Transfer Rate	Access Time	Price
MultiSpin 6Xi (internal)	900 KB/sec	145ms	\$485
MultiSpin 6Xe (external)	900 KB/sec	145ms	\$590
MultiSpin 3Xp Plus	500 KB/sec	240ms	\$399
Changers - Quick, convenient access for up to 7 CDs:			
MultiSpin 4Xc	600 KB/sec	350ms	\$399

NEC Ready 5010

\$1,599

or lease from
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NEC PowerMate® P133

\$2,749

or lease from
\$75/month

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NEC PowerMate Systems combine power-computing technologies, infrared connectivity and unique DMI productivity software to give you one of the fastest, most reliable systems available. PowerMate offers multimedia and networking configurations and a dual operating system hotload of MS DOS™ 6.22 & Windows for Workgroups™ or Windows® 95. You choose!

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Model	Processor	HD	Memory	Price
Ready 5010	Intel® i486 DX4/100MHz	540MB	8MB RAM	\$1,599
Ready 7022	Pentium® 75MHz	1.0GB	8MB RAM	\$1,899
Ready 9022	Pentium 100MHz	1.0GB	8MB RAM	\$2,299
Ready 9522	Pentium 100MHz	1.6GB	16MB RAM	\$2,699
Ready 9532	Pentium 120MHz	1.6GB	16MB RAM	\$2,999
Ready 9542	Pentium 133MHz	1.6GB	16MB RAM	\$3,299

Model	Processor	HD	Memory	Price
PowerMate V466	Intel i486 DX2/66MHz	540MB	8MB RAM	\$1,229
PowerMate VP75	Pentium 75MHz	540MB	8MB RAM	\$1,479
PowerMate V90	Pentium 90MHz	540MB	8MB RAM	\$1,599
PowerMate V100	Pentium 100MHz	540MB	8MB RAM	\$1,699
PowerMate P120	Pentium 120MHz	1.2GB	16MB RAM	\$2,499
PowerMate P133	Pentium 133MHz	1.2GB	16MB RAM	\$2,749

†Monitors not included in price.

NEC SUPERScript™: POWERFUL PRINTING POSSIBILITIES

Model	Resolution	PPM	Price
SuperScript C3000	300 dpi Wax Thermal Transfer; 300 dpi Variable Dot Thermal; 300 dpi Dye Sublimation	N/A	\$969
SuperScript 660i	600 dpi	6ppm	\$679
SuperScript 660	600 dpi	6ppm	\$499
SuperScript 610 Plus	300 dpi	6ppm	\$399



NEC SuperScript Color 3000

\$969

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Model	Screen	DPI	Max Resolution	Price
Multisync XV14	14" diagonal CRT 13.0" viewable image size	.28mm	1024 x 768 HI	\$ 919
Multisync XV15	15" diagonal flat square CRT 13.8" viewable image size	.28mm	1280 x 1024 HI	\$ 999
Multisync XV17	17" diagonal flat square CRT 15.6" viewable image size	.28mm	1280 x 1024 HI	\$ 779
Multisync XE21	21" diagonal flat square CRT 18.8" viewable image size	.28mm	1024 x 768 HI	\$1,549

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21-inch, digitally-controlled, fully-featured, multi-scanning color monitor



- 21" flat, square screen color monitor
- 28 mm dot pitch
- Supports VGA up to 1600 x 1200 @ 66Hz
- Digital, microprocessor controls
- Easy Menu™ on screen programming
- Dual dynamic focus, anti-static/anti-glare, AR coating, linear mask
- Low radiation, MPRII compliant, Energy Star

SuperScan Elite 21

Same as above but supports 1600x1200 at 76Hz refresh, plus higher refresh rates at all lower resolutions

\$1925

SuperScan Supreme 21

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- Supports 300 dpi scans up to 11" wide

Draftsman PLUS LF

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- Supports 300 dpi scans up to 100"x100"



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- ADI, MS Windows compatible, MS Mouse emulation

DrawingBoard III 12x18

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ScanMaker IISP	\$469
ScanMaker IIHR	\$559

Mustek	
Paragon 600 IISP	\$399
Paragon 1200 Le	\$499
Paragon Office	\$549
Paragon 800SP	\$499

Plustek	
PageReader 800	\$169
ScanPlus Color	\$249
ScanPlus FX	\$499

Relisys	
Aver Office Pro	\$349

Great features, great software, great price

- 24 bit, 16.8 million colors
- 8 1/2" x 14" scan area
- 600x300 dpi optical
- Software included
- Photo Studio, Text Bridge, Papermaster and Cypherscan

Reli 4830T	\$999
Reli 9612T	\$1099
Reli 9624T w/3.0	\$1299

Digitizers

Calcomp	
DrawingBoard III 12x12	\$225
DrawingBoard III 12x18	\$359
DrawingSlate II 4x5	\$145
DrawingSlate II 6x9	\$195
DrawingSlate II 12x12	\$225

SummaGraphics	
Summasketch III 12x12	\$215

- Your choice:
- 4 or 16 button cursor
- 2450 lpi;
- .010 accuracy
- ADI, MS Windows, MS mouse emulation

Summasketch III 12x18	\$409
-----------------------	-------

Wacom	
ArtPad II 4 x 5	\$145
ArtPad II 4 x 5 with Dabblor	\$169
ArtZ II 6 x 9 Graphuc Tablet	\$319
ArtZ II 12 x 12	\$429

Plotters

CalComp	
Designmate 3024s A-D size	\$1275
Designmate 3036s A-E size	\$1749
Techjet Personal	\$565
Techjet Designer 720 A-D	\$2175
Techjet Designer 720 E size	\$2775
Techjet Color A-D size	\$3995
Techjet Color A-E size	\$4495

HI/Summagraphics	
DMP 161 A-D size	\$1249
DMP 162 A-E size	\$1875
DMP 162R roll feed	\$CALL
HiPlot 7100 A-D size	\$1485
HiPlot 7200 A-E size	\$CALL
JetPro A-C size inkjet	\$1045
Summajet Mono A-D size	\$1875
Summajet Mono A-E size	\$2375
Summajet Color A-D size	\$2095
Summajet Color A-E size	\$2595

Monitors

Hitachi NSA	
17" Elite - CM1711	\$849
20" Pro - CM2011	\$1270
20" Elite - CM2098	\$1579
21" Elite - CM2111	\$1925
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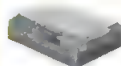
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Single Pass Color Scanner with Full Photoshop 3.0!



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- Won PC Magazine's Editors' Choice Award

ScanMaker IISP

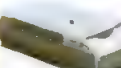
- With ImageStar and OmniPage

\$469

ScanMaker III

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36-bit single pass scanner captures 68 billion colors!



- 1200x600 dpi optical res., 2400x2400 interpolated
- Full Photoshop 3.0, Scan Wizard, and DCR color calibration software, and OmniPage Direct OCR
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Paragon 600 IISP

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- Single Pass Color Scanner
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Paragon 800SP

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Exceptional 30-bit captures over a billion colors!



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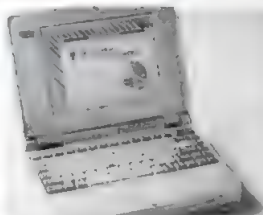
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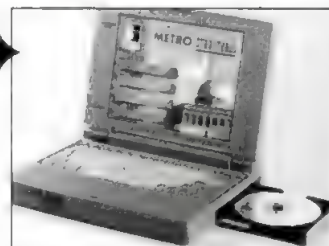
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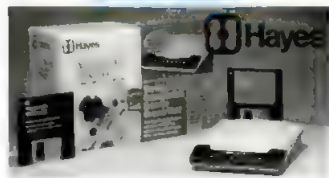
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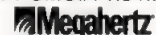
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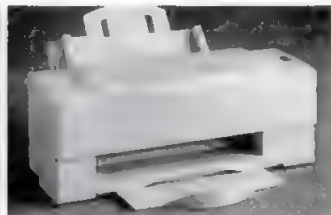
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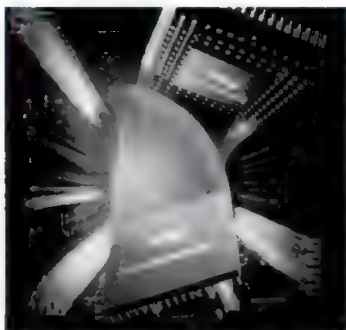
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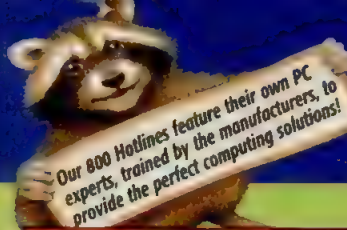
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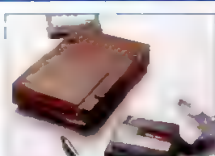
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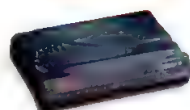
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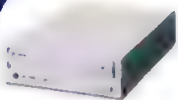
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PRINCETON®
GRAPHIC SYSTEMS

Ultra 17" Monitor
The best value in 17" Monitors



For more on this turn to page 36

\$599
CMPGU17

AST
Authorized Reseller

Bravo Pentium® 75



For more on this turn to page 7

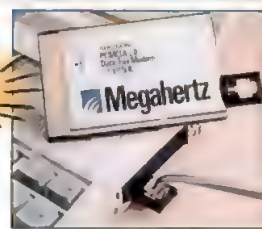
\$1,899
501772-901

Megahertz®

X-Jack 28.8/14.4 PC Card

Megahertz Fax Modems with XJACK™ combine PC Card standards with Megahertz's patented XJACK™ connector for easy-to-install, credit card modems which hook directly to your phone jack. Megahertz's patented XJACK™ (expandable jack) is the simplest, most practical connector available. **Three times more rugged than other PCMCIA connectors!**

• PC Card Standard • 28.8/14.4 data/fax modem



For more on this turn to page 15

\$289
MBXJ2288

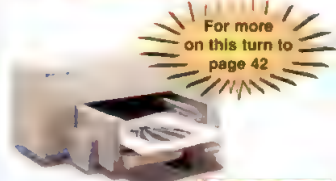
TEXAS INSTRUMENTS
Extensa 450



For more on this turn to page 15

\$1,799
TEXT450CS3

hp HEWLETT® PACKARD
HP DeskJet 600



For more on this turn to page 42

\$299
HPDJ600

MOTOROLA

PCMCIA 28.8, V.34/Ethernet Combo
The PC Card Connectivity King

The New Marquis PC Card from Motorola combines a high performance Ethernet LAN adapter with a powerful 28.8 modem/fax for screamin' fast connectivity whether you're in the office or on the road. An intelligent "installation engine" assures fast and easy installation on all leading portable computers.

- 28.8Kbps with true V.34 modulation
- 3COM LAN technology
- Simultaneous LAN/Modem Operation

For more on this turn to page 16

\$499
MBMOTM28LP



800-488-0001

What's Hot What's Hot What's Hot

EPSON

Stylus Color II



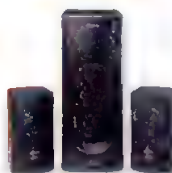
For more
Epson printers
see page 41

\$449
EPSSCLRII

SONY

SRS-D4K 30-Watt Shielded Speakers

Up to 30 watts total output power from this compact three-piece shielded speaker system with superior low frequency reproduction and exceptionally rich sound.



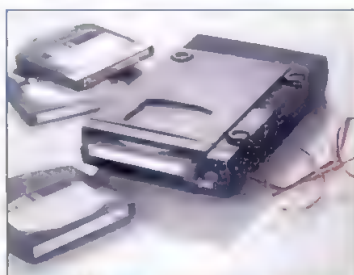
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SESRSD4K

More Sony
products on
pages 28 & 45

1 JAZZ Drive—The Fast 1 Gigabyte Removable Solution

Jaz Drives and disks are the ideal solution for storing, transporting and playing multimedia applications.

- Faster than most hard drives
- 1GB of disk space on each compact cartridge
- Up to 6.73MB/second transfer rate
- 17ms access time
- 256K buffer



For more
Iomega turn to
page 34

\$599
IOJAZEXT

Microsoft

Microsoft Office



For more
on this turn to
page 75

\$189.95
Upgrade 3.5" - 217004

COREL

Corel Draw 6



For more
on this turn to
page 67

\$229
Upgrade from 5 to 6 - 217662
\$439
Full Version 6 - 217660

SYMANTEC

Norton Utilities 95



For more
on this turn to
page 74

\$55.95
Upgrade - 217013

NEC

MultiSpin® 4Xc 7-Disc Changer

Delivers quad-speed performance for incredibly smooth motion and fast access to data. Plus, you enjoy the convenience of having seven CDs loaded in your changer, ready to go!

- 600KB/sec transfer rate
- 350ms access time



For more
on this turn to
page 28

\$359
ODNCC302

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Computers

IBM®



pentium®
PROCESSOR

Don't forget to see our selection of IBM notebooks on pages 16-17!



Shown with optional monitor

IBM PC 300 Series

The powerful stand-alone solution

The PC 300 Pentium® product line was expanded by IBM with the addition of a new set of high-performance Pentium® systems. These high-speed performers are designed to deliver state-of-the-art technology, advanced industrial design, and IBM quality, service, and support at surprisingly affordable prices. The price performance breakthrough achieved by the new PC 300 Pentium® systems set a whole new standard in value.

The IBM PC 300 Series has virtually everything users look for in a general computing family: Pentium® processors, PCI/ISA Bus technology, 3-slot/3-bay or 5-slot/5-bay design, keyboard and large capacity hardfiles.

Each PC 300 Pentium® system comes equipped with SelectaSystem, a Dual Boot feature, which gives every user the best of all worlds (OS/2 Warp, DOS, and Windows) at no additional charge.

- Up to 100MHz Pentium® Processor
- 8MB or 16MB RAM
- 540MB or 850MB Hard Drive
- Local Bus IDE Controller
- PCI Local Bus, 64-bit with 1MB DRAM
- DOS, Windows, OS/2 Warp and Easy Tools
- 3 year manufacturer's warranty

\$2,196

PC 350 Pentium® 90MHz
16MB RAM, 540MB HDD
IBA658645H

IBM PC 300 Models

Model	Processor	RAM/HDD	Slots x Bays	Prod. Code	Price
PC 330	Pentium® 75MHz	8/540MB	3 x 3	IBA657635F	\$1,622
PC 330	Pentium® 75MHz	16/540MB	3 x 3	IBA657635H	1,966
PC 330	Pentium® 75MHz	16/850MB	3 x 3	IBA657637H	2,082
PC 350	486DX2/66MHz	8/540MB	5 x 5	IBA6581L5F	1,645
PC 350	Pentium® 75MHz	8/540MB	5 x 5	IBA658635F	1,679
PC 350	Pentium® 75MHz	16/540MB	5 x 5	IBA658635H	2,024
PC 350	Pentium® 75MHz	16/850MB	5 x 5	IBA658637H	2,139
PC 330	Pentium® 90MHz	8/540MB	3 x 3	IBA657645F	1,794
PC 330	Pentium® 90MHz	16/540MB	3 x 3	IBA657645H	2,139
PC 330	Pentium® 90MHz	16/850MB	3 x 3	IBA657647H	2,254
PC 350	Pentium® 90MHz	8/540MB	5 x 5	IBA658645F	1,852
PC 350	Pentium® 90MHz	16/540MB	5 x 5	IBA658645H	2,196
PC 350	Pentium® 90MHz	16/850MB	5 x 5	IBA658647H	2,312
PC 330	Pentium® 100MHz	8/540MB	3 x 3	IBA657655F	1,909
PC 330	Pentium® 100MHz	16/540MB	3 x 3	IBA657655H	2,254
PC 330	Pentium® 100MHz	16/850MB	3 x 3	IBA657657H	2,369
PC 350	Pentium® 100MHz	8/540MB	5 x 5	IBA658655F	1,966
PC 350	Pentium® 100MHz	16/540MB	5 x 5	IBA658655H	2,312
PC 350	Pentium® 100MHz	16/850MB	5 x 5	IBA658657H	2,426



Shown with optional monitor

\$1,622

PC 330 Pentium® 75MHz
8MB RAM, 540MB HDD
IBA657635F



pentium®
PROCESSOR

free

FREE Starter Kit with purchase of any Pentium® desktop system in this catalog—a \$89 value! See the back cover for complete details.

4

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365 days a year.





IBM

PC 700 Series

The powerful network solution

Enhanced to support your most advanced applications. PC 700s reflect IBM's pledge to help make owning and managing business computers simpler than ever.

The IBM PC 700 Series systems provide leadership technology and advanced industrial design. These systems greatly increase system power to help you process, manage, and interpret vital business data in more sophisticated and valuable ways than ever before. The IBM PC 700s are designed to be the ideal network machine—and a system administrator's dream. Smart, built-in network support features make administration almost automatic—even from a remote location.



Shown with optional monitor



- Pentium® 75MHz through 120MHz processors available
- 16MB RAM, expandable to 192MB
- 540MB or 1GB hard drive
- Enhanced PCI Local Bus IDE controller
- 1.44MB, 3.5" floppy drive

- DOS, Windows, & Easy Tools
- 64-bit PCI graphics adapter with 1MB DRAM
- 3 year manufacturer's warranty (1 year on-site warranty)

\$2,380

PC 700 Pentium® 75MHz
16MB RAM, 540MB HDD
IBA688535H

IBM PC 700 Models

Model	Processor	RAM/HDD	Slots x Bays	Prod. Code	Price
PC 700	Pentium® 75MHz	16/540MB	5 x 5	IBA688535H	\$2,380
PC 700	Pentium® 75MHz	16/540MB	5 x 5*	IBA688635H	2,553
PC 700	Pentium® 90MHz	16/540MB	5 x 5	IBA688545H	2,869
PC 700	Pentium® 90MHz	16/540MB	5 x 5*	IBA688645H	2,725
PC 700	Pentium® 100MHz	16/540MB	5 x 5	IBA688555H	2,668
PC 700	Pentium® 100MHz	16/540MB	5 x 5*	IBA688655H	2,984
PC 700	Pentium® 120MHz	16/1GB	5 x 5*	IBA688668H	3,567

*MCA - Denotes Micro Channel Architecture

Aptiva

Fully featured multimedia at a great low price!

- Pentium® 75MHz processor or Pentium® 100MHz processor
- 8MB RAM upgradable to 128MB
- 1GB hard drive
- 4X CD-ROM drive
- 3.5" 1.44MB floppy drive
- 30-watt speakers
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- Advanced telephony center with full duplex line
- Over 40 software titles
- Keyboard
- Mouse
- 24-hour support with on-line HouseCall and Voice-over-data



Shown with optional monitor

IBM power and performance for your home!



\$1,899

Pentium® 75MHz
8MB RAM, 1GB HDD
IBA2144M40

IBM Aptiva Models

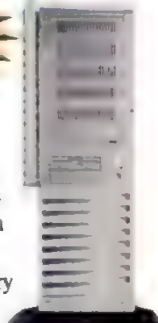
Model	Processor	RAM/HDD	Case	Prod. Code	Price
Aptiva	Pentium® 75MHz	8/1GB	Mini Tower	IBA2144M40	\$1,899
Aptiva	Pentium® 100MHz	8/1GB	Desktop	IBA2144M50	2,199

IBM PC Server 320

Add a second processor for extra power!



The IBM PC Server 320 significantly expands the function of IBM's industry standard PC Server 300 line which is designed for customers desiring PCI and EISA bus architectures. The PC Server 300 line gives current EISA and ISA bus customers a migration path to PCI technology with a reliable, functionally rich PC Server 320 supported by a vast support network. These servers are designed primarily as entry enterprise LAN servers to efficiently connect large numbers of clients for file and data base server applications.



- 90MHz Pentium® Processor, and a second ZIF socket for an optional 90MHz Pentium® symmetrical multiprocessing (SMP) upgrade
- 16MB Standard Memory, expandable to 256MB maximum
- SVGA graphics adapter with 1MB DRAM
- Standard double speed SCSI CD-ROM Drive
- Nine 32-bit slots
- Includes an integrated IDE controller running on the ISA bus
- Two Serial ports, One Parallel port
- IBM keyboard and mouse
- Front-door with keylock to secure diskette and other removable media devices
- 3 year on-site warranty

IBM PC Server 320

Model	Processor	RAM/HDD	Case	Prod. Code	Price
PC Server 320	Pentium® 90MHz	16MB/1.1GB	Tower	IBA86400YT	\$5,699
PC Server 320	Pentium® 90MHz	16MB/2.2GB	Tower	IBA86401YT	8,499



800-488-0001





AST[®]

Authorized Reseller

pentium[®]
PROCESSOR

Advantage! Series features:

Getting started is a snap with pre-installed software!

- 100MHz through 133MHz Pentium[®] processors available
- 8MB or 16MB RAM (128MB max.)
- 850MB or 1.2 or 1.6GB IDE hard drive
- 3.5" 1.44MB floppy drive
- Quad Speed IDE CD-ROM
- 16-bit integrated sound
- Speakers

- Microphone
- 14.4 fax/data modem w/SP and Radish or ATi 28.8 fax/data modem w/SP and Radish
- Two case styles available—desktop or mini tower
- Windows[®] 95
- Keyboard and Mouse
- Includes Microsoft Windows[®] 95 and 13 other software titles
- 1 year on-site warranty

\$1,899
**1000 Pentium[®] 100MHz
16MB RAM, 850MB HDD
501768-001**

AST Advantage! Models

Model	Processor	RAM/HDD	Case	Product Code	Price
614	Pentium [®] 100MHz	8/850MB	Desktop	501768-001	\$1,899
812	Pentium [®] 100MHz	8/1.2GB	Mini Tower	501856-001	2,099
814	Pentium [®] 100MHz	8/1.2GB	Mini Tower	501769-001	2,399
818	Pentium [®] 133MHz	16/1.6GB	Mini Tower	501794-001	2,999

Windows[®] 95
FREE with any Advantage system!

Premia MX Series:

Pentium processing, fast graphics and PCI!

- Pentium[®] 75MHz processor
- 8MB or 16MB RAM expandable to 128MB
- 540MB or 1GB hard drive
- 3.5" 1.44MB floppy drive
- 256K cache
- Accelerated 64-bit PCI local bus
- 2MB VRAM (4MB Maximum)
- Includes DOS and Windows

- Type III PCMCIA model available for quick data transfer and additional enhancements
- AST FlashBIOS includes DMI[®] (Desktop Management Interface) for managing networked desktop assets and plug-and-play capabilities
- Full-size chassis which improves quick installation through sliding rails for internal hard drives
- 3 year warranty, 1 year on-site warranty

Call about the new 133MHz systems!

Premia MX Models

Processor	RAM/HDD	Case	Product Code	Price
Pentium [®] 75MHz	8/540MB	Desktop	501699-201	\$2,119
Pentium [®] 75MHz	8/540MB*	Desktop	501699-301	2,289
Pentium [®] 75MHz	16/1GB w/CD	Desktop	501699-401	2,899

* Includes PCMCIA Type III slot


Premia GX Series:

Dual Pentium[®] processor capable!

Just imagine facing the world with not only one but two Pentium[®] CPUs. You accomplish the most tedious of feats in half the time. Take on multiple tasks

all at once. It's like having the strength of two computers. The optional dual processors easily let you run the latest 32-bit operating systems.

- Dual processor and overdrive capable
- Accelerated 64-bit PCI ATI Match 64 graphics card with 2MB VRAM
- 3.5" 1.44MB floppy drive, 101-key keyboard
- 256K cache
- Integrated Ethernet adapter
- AST Flash BIOS including Desktop Management Interface for managing networked desktop assets and plug-and-play add-ons
- 3 year manufacturer's warranty (1 year on-site warranty)

\$3,699
**Premia Pentium[®] 100MHz
16MB RAM, 1GB HDD
501522-201**

Insight is a
NASDAQ
traded company

Home or office, you'll find the right printer for your computer system on pages 41 and 42.



Bravo MS Series

Practical solutions for business computing

Powerful, reliable and value priced, Bravo desktops have been a remarkable force in business computing. For over five years, the Bravo series has delivered practical computing solutions to businesses around the world, earning a distinguished reputation for value. The Bravo MS desktops offer the remarkable speed of Pentium® technology in two different chassis designs, to meet your needs perfectly.

The Bravo MS series incorporates PCI-based graphics, putting the controller on the PCI bus for maximum

speed. 64-bit performance is achieved with up to 2MB of graphics RAM.

The Bravo MS series of computers are not just fast to operate, they're fast to configure too. Their industry-leading design supports future Plug and Play and DMI standards. BIOS upgrades are easy as well, thanks to the AST® FlashBIOS system. Boot the upgrades off a diskette and you're ready to run!

- Pentium® 75MHz through 133MHz processors available
- 8MB or 16MB RAM (128MB Max)
- 256K cache
- 850MB through 1.6GB IDE HDD
- Accelerated 64-bit PCI Local Bus graphics
- Dual boot option of MS Windows 3.11 or MS Windows® 95
- Two case styles available:
 - Desktop
 - Mini Tower
- EPA Energy Star, VESA & DPMS compliant
- 3 year manufacturer's warranty (1 year on-site warranty)

\$2,159

MS-T Pentium® 100MHz
8MB RAM, 850MB HDD
501777-301

AST Bravo MS Models

Processor	RAM/HDD	Case Style	Product Code	Price
75MHz Pentium®	8/850MB	Desktop	501772-701	\$1,729
75MHz Pentium®	8/850MB w/CD	Desktop	501772-901	1,899
75MHz Pentium®	16/1.2GB	Desktop	501772-801	2,199
100MHz Pentium®	8/850MB	Desktop	501774-301	2,099
100MHz Pentium®	8/850MB w/CD	Desktop	501774-601	2,269
100MHz Pentium®	16/1.2GB	Desktop	501774-501	2,579
120MHz Pentium®	16/1.2GB	Desktop	501814-401	2,699
120MHz Pentium®	16/1.6GB	Desktop	501814-601	2,989
120MHz Pentium®	16/1.6GB w/CD	Desktop	501814-801	3,159
133MHz Pentium®	16/1.2GB	Desktop	501815-401	2,809
133MHz Pentium®	16/1.6GB	Desktop	501815-601	3,099

AST Bravo MS-T Models

Processor	RAM/HDD	Case Style	Product Code	Price
100MHz Pentium®	8/850MB	Mini Tower	501777-301	\$2,159
100MHz Pentium®	16/1.2GB	Mini Tower	501777-501	2,639
133MHz Pentium®	16/1.6GB	Mini Tower	501860-801	3,329

AST Vision Monitors

AST Vision Monitors

Model	Size	Resolution	INT/NI	Dot Pitch	Prod. Code	Price
Vision 5V	15"	1024 x 768	NI	.28mm	501718-001	\$359
Vision 5M	15"	1024 x 768	NI	.28mm	501790-001*	469

* Comes with Multimedia Features including:

- Two 2.5-watt integrated speakers
- Headphone and microphone jacks
- Onco-directional microphone
- Volume and mute controls



**Three Year
On-Site
Warranty!**

Call about
the new 133MHz
systems!

Manhattan Server

RAID system available for the ultimate in data protection

- Pentium® 90MHz and 100MHz processors with dual Pentium power
- 16MB/32MB standard, expandable to 256MB
- Up to 8GB hard drive (array)
- Integrated PCI-based Fast SCSI-2 controller
- SCO Unix, Microsoft NT, Novell, Banyan, and OS/2 software certification

- Plug and Play support
- ZIF socket supports dual Pentium and future OverDrive capability
- AST Array Storage Manager simplifies management of AST Array subsystems
- AST Percepta Server Management software providing a pictorial, easy-to-use analysis of the system
- 3 year on-site warranty

\$4,069

Manhattan V5090
Pentium® 75MHz, 1GBHDD
501500-003

AST Manhattan Server Models

Model	Processor	RAM/HDD	Case	Product Code	Price
V5090	Pentium® 90MHz	16/1GB	Tower	501500-003	\$4,069
V5090	Pentium® 90MHz	16/2GB	Tower	501500-005	4,469
P5090	Pentium® 90MHz	16/1GB	Tower	501502-003	4,729
P5090	Pentium® 90MHz	16/2GB	Tower	501502-005	5,229
P5090	Pentium® 90MHz	16/4GB*	Tower	501502-009	7,839
P5100	Pentium® 100MHz	32/4GB*	Tower	501503-221	9,699
P5100	Pentium® 100MHz	32/8GB*	Tower	501503-241	11,029

* Array

free

FREE Starter Kit with purchase of any Pentium® desktop system in this catalog—a \$89 value!
See the back cover for complete details.



800-488-0001

7



COMPAQ



ProLinea Desktop

Plug-and-play compatible for easy upgrades

- Choice of processors ranging from 486DX2/66MHz to Pentium® 133MHz
- 8MB or 16MB RAM
- 630MB to 1GB hard drive
- TriFlex/PCI architecture
- Multi-media models available with Internal QuadSpeed CD-ROM drive, Enhanced Business Audio and Microsoft Windows Sound System
- Graphics controller ranging from Integrated PCI Local Bus to high-performance QVision 2000+

- Integrated PCI Local Bus IDE controller
- Pentium® OverDrive socket
- 1.44MB 3.5" floppy drive
- Three slot/three bay or four slot/four bay form factor
- EPA Energy Star compliant
- Full plug-and-play functionality, Windows® 95 ready
- 101-key keyboard and mouse
- 3 year manufacturer's warranty (1 year on-site warranty)

\$1,359

Compaq ProLinea 466
8MB RAM, 630MB HDD
172200-004

Certain Compaq models not available in all areas.

Compaq ProLinea Models

Model	Processor	RAM/HDD	Case	Prod. Code	Price
ProLinea 466	486DX2/66MHz	8/630MB	Desktop	172200-004	\$1,359
ProLinea 466	486DX2/66MHz	8/630MB w/CD	Desktop	172700-006	1,709
ProLinea 575	Pentium® 75MHz	8/630MB	Desktop	172900-006	1,679
ProLinea 575	Pentium® 75MHz	16/1GB	Desktop	172930-002	2,199
ProLinea 575	Pentium® 75MHz	16/1GB w/CD	Desktop	172930-003	2,459
ProLinea 590	Pentium® 90MHz	8/630MB	Desktop	173000-006	1,949
ProLinea 590	Pentium® 90MHz	16/1GB	Desktop	173090-002	2,469
ProLinea 590	Pentium® 90MHz	16/1GB w/CD	Desktop	173090-003	2,729
ProLinea 5120	Pentium® 120MHz	16/1GB	Desktop	222620-003	2,799
ProLinea 575	Pentium® 75MHz	8/630MB	MTower	173100-006	1,729
ProLinea 575	Pentium® 75MHz	16/1GB	MTower	173150-002	2,249
ProLinea 575	Pentium® 75MHz	16/1GB w/CD	MTower	173150-003	2,499
ProLinea 5100	Pentium® 100MHz	16/1GB	MTower	178300-005	2,549
ProLinea 5133	Pentium® 133MHz	16/1GB	MTower	222630-003	3,079

Compaq Deskpro Models

Model	Processor	RAM/HDD	Case	Prod. Code	Price
Deskpro 466	486DX2/66MHz	8/630MB	Desktop	172500-006	\$1,519
Deskpro 575	Pentium® 75MHz	8/630MB	Desktop	173500-002	1,949
Deskpro 575	Pentium® 75MHz	8/1GB	Desktop	173550-002	2,469
Deskpro 575	Pentium® 75MHz	8/1GB w/CD	Desktop	173550-004	2,729
Deskpro 590	Pentium® 90MHz	8/630MB	Desktop	173600-002	2,219
Deskpro 590	Pentium® 90MHz	16/1GB	Desktop	173650-002	2,739
Deskpro 590	Pentium® 90MHz	16/1GB w/CD	Desktop	173650-003	2,989
Deskpro 5120	Pentium® 120MHz	16/1GB	Desktop	222720-003	3,059
Deskpro 5133	Pentium® 133MHz	16/1GB	Desktop	222710-003	3,297
Deskpro 575	Pentium® 75MHz	8/630MB	MTower	173700-007	1,995
Deskpro 575	Pentium® 75MHz	16/1GB	MTower	173750-002	2,575
Deskpro 590	Pentium® 90MHz	8/630MB	MTower	174600-007	2,249
Deskpro 590	Pentium® 90MHz	16/1GB	MTower	174650-002	2,779
Deskpro 5100	Pentium® 100MHz	16/1GB	MTower	178200-005	2,815
Deskpro 5133	Pentium® 133MHz	16/1GB	MTower	222730-003	3,345



Shown with optional monitor

Deskpro XL Desktop

Integrated network controller makes LAN connection easier than ever!

- Powerful processors ranging from 90MHz to 133MHz Pentium®
- 16MB RAM
- 1GB hard drive
- 256K write-back secondary cache standard
- TriFlex/PCI on high performance Pentium models
- QVision 1280/P or QVision 2000 PCI local bus graphics controller
- Integrated 32-bit PCI Ethernet Controller

- Integrated 32-bit PCI Fast-SCSI-2 Controller
- Energy saving features including time-out option for CPU, hard drive and monitor
- Business Audio with Microsoft Windows Sound System software included
- Support for full plug-and-play expansion cards and operating system
- 1.44MB 3.5" floppy drive
- 101-key keyboard and mouse
- 3 year manufacturer's warranty (1 year on-site warranty)

\$3,365

Compaq Deskpro XL 590
16MB RAM, 1GB HDD
148300-008

Compaq Deskpro XL Models

Model	Processor	RAM/HDD	Case	Prod. Code	Price
Deskpro XL 590	Pentium® 90MHz	16/1GB	Desktop	148300-008	\$3,365
Deskpro XL 5100	Pentium® 100MHz	16/1GB	Desktop	213200-008	3,399
Deskpro XL 5120	Pentium® 120MHz	16/1GB	Desktop	222500-008	3,809
Deskpro XL 5133	Pentium® 133MHz	16/1GB	Desktop	223300-007	4,049





Packard Bell™

All New Packard Bell Force lineup now available from Insight!



Shown with optional Monitor

Force 480

- 75MHz Pentium® processor
- 8MB RAM, expandable to 72MB
- 850MB hard drive
- 1MB Video RAM, expandable to 2MB
- Quad-speed, IDE CD-ROM drive
- 3.5", 1.44 MB floppy drive

- 14.4 bps fax/modem
- 16-bit SRS® 3-D Amphitheater Stereo Sound™ and Speakers, SoundBlaster™ compatible

\$1,599

75MHz Pentium® Processor
8MB RAM, 850MB HDD
PBF480

Packard Bell Systems

Model	Processor	RAM/HDD	Case	Prod. Code	Price
Force 261+	486DX2/66MHz	8MB/540MB	Desktop	PBF261+	\$1,199
Force 480	Pentium® 75MHz	8MB/850MB	Desktop	PBF480	1,599
Force 484	Pentium® 75MHz	8MB/1.2GB	Desktop 2000	PBF484	1,929
Force 487	Pentium® 75MHz	16MB/1.2GB	Mini Tower	PBF487	1,999
Spectria 310	Pentium® 75MHz	8MB/850MB	All-in-one	PBSB310	1,929
Force 860	Pentium® 100MHz	8MB/850MB	Desktop	PBF860	1,799
Force 872	Pentium® 100MHz	16MB/1.6GB	Mini Tower	PBF872	2,399
Force 998	Pentium® 133MHz	16MB/1.2GB	Tower	PBF998	2,649
Force 999	Pentium® 133MHz	16MB/2.1GB	Mini Tower	PBF999	2,849

Packard Bell's Navigator Gets You Off To A Flying Start

Packard Bell's Navigator makes computing easier for everyone in your home and business and comes pre-loaded on all systems.

Simply turn on your new Packard Bell system and you'll be greeted with six icons on an uncluttered screen. Choose between "Getting Started", "Tutorials", "Services and Support", "Software", "Windows", and "Exit MS-DOS" by pointing and clicking your mouse on the desired subject.

The bottom-line is Packard Bell's Navigator is the newest and easiest way to use your new computer. You always know where you are, and how to get to where you want to go. So let Navigator get you off to a "Flying Start" towards hours of happy, productive computing.

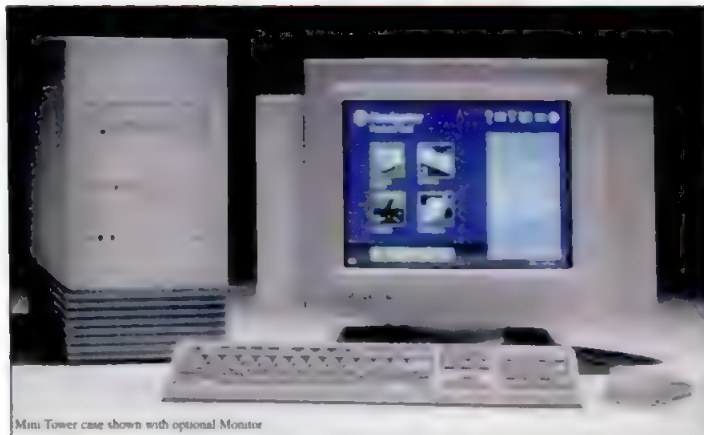
Computers



pentium®

Windows 95

FREE with Packard Bell systems! Call!



Mini Tower case shown with optional Monitor

Force 872

- 100MHz Pentium® processor
- 16MB RAM, expandable to 72MB
- 1.6GB hard drive
- 1MB Video RAM, expandable to 2MB
- Quad-speed, IDE CD-ROM drive
- 3.5", 1.44MB floppy drive

- 28.8 bps fax/modem
- 16-bit SRS® 3-D Amphitheater Stereo Sound™ and Speakers, SoundBlaster™ compatible

\$2,399

100MHz Pentium® Processor
16MB RAM, 1.6GB HDD
PBF872



Over \$1,000 worth of software included!

SERVICE and SUPPORT from PACKARD BELL

- FREE Hardware Technical Support by phone available 24 hours a day, seven days a week.
- Technical Support for users requiring configuration help with included software.
- One year ON-SITE service in your home or office.



800-488-0001

9



Computers



Made by one of the world's largest computer manufacturers—

The Inteva line gives you high-end quality at incredible savings



Inteva Systems

- AMD 486DX4/100 enhanced processor
- 4MB or 8MB RAM, 128K or 256K cache
- 540MB or 850MB hard drive available
- 3.5" floppy drive
- 64-bit 1MB PCI local bus video
- 64-bit PCI IDE controller
- 104-key enhanced keyboard
- Microsoft Mouse
- 2 serial, 1 parallel, 1 game port
- Windows® 95
- Toll-free technical support
- 1 year on-site manufacturer's service warranty

Inteva Multimedia Systems

- AMD 486DX4/100MHz enhanced processor
- 8MB or 16MB RAM, 128K or 256K cache
- 1.2GB hard drive
- Sony Quad-speed IDE CD-ROM drive
- 16-bit stereo sound card w/speakers
- 64-bit 1MB PCI local bus video
- 64-bit PCI IDE controller
- 14.4bps voice/data/fax modem with SuperVoice software
- 104-key enhanced keyboard
- Microsoft Mouse
- 2 serial, 1 parallel, 1 game port
- Windows® 95
- Toll-free technical support
- 1 year on-site manufacturer's service warranty

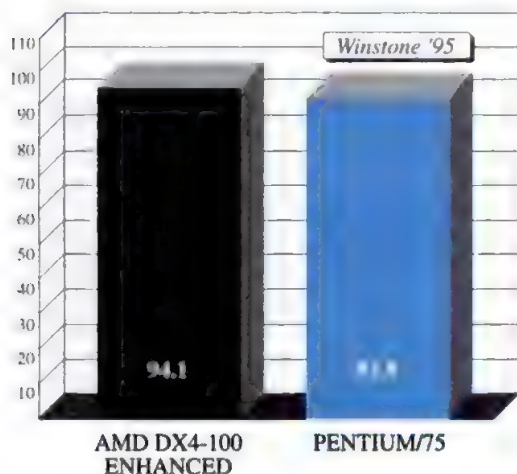
\$899

Inteva 486DX4/100E
4MB RAM, 540MB HDD
ITV100E45

\$1,699

Inteva 486DX4/100E
16MB RAM, 1.2GB HDD
ITV100E11M

Performance Comparison
AMD486DX4-100 Enhanced vs. Pentium 75



Superior engine to run Windows 95; Excellent solution for high performance multimedia systems; and 586 class performance, 486 system price!



Monitor sold separately.

Inteva Systems

Processor	RAM/HDD	Case Style	Product Code	Price
AMD 486DX4/100E	4/540MB	Mini Tower	ITV100E45	\$899
AMD 486DX4/100E	8/540MB	Mini Tower	ITV100E85	1,099
AMD 486DX4/100E	850MB w/CD	Mini Tower	ITV100E88C	1,299
AMD 486DX4/100E	8/1.2GB MM	Mini Tower	ITV100E81M	1,499
AMD 486DX4/100E	16/1.2GB MM	Mini Tower	ITV100E11M	1,699



NEW!
Am486DX4/130
Enhanced—
Outperforms the
Pentium® 75MHz

Free software

with every Inteva Multimedia Computer
WordPerfect® Mainstreet™ Free!

As part of your Inteva Multimedia Bundle, you will receive the WordPerfect® Mainstreet™ software package. This bundle includes the following:

- WordPerfect Works 2.0 for Windows
- ClipArt Home
- Random House School and Office Dictionary
- Recent Events of the 1990's
- CIA World Fact Book
- Webster's New World Dictionary, Third College Edition
- Grolier's Multimedia Encyclopedia including:
 - 33,000 articles from the Academic American Encyclopedia
 - 8,000 pictures
 - Pathmakers
 - New graphical Timeline
 - Over 325 new high-detailed maps
 - New narrated animations
 - New and improved Word Search capabilities
- Info Central 1.1
- Grammatik 6
- Wallobee Jack: The Lost Lionardo
- Interactive World Atlas
- Consumer Information
- Webster's New World Thesaurus, New Revised Edition

Windows® 95
Pre-installed on every Inteva system!

10

Call and get your **FREE** catalog subscription.



Protect your investment! See page 49 for power protectors and software on pages 54, 55 and 74 for virus and network protection and backup.

AST®

Authorized Reseller



pentium®

Ascentia 950N

The Pentium notebook that brings it all together with infrared connectivity, multimedia capabilities and super VGA 800x600 resolution

- Pentium® 75MHz processor
- 10.4" color display
- 8MB RAM expandable to 40MB
- Up to 1.2GB hard drive
- 2 Type II or 1 Type III PC Card slots
- Integrated SmartPoint™ pointing device
- Wireless infrared port

- Built-in SoundBlaster Vibra 16 hardware and software
- Lithium ion battery
- Pre-installed software including: DOS, Windows, Windows® 95, Prodigy, America On-Line & CompuServe starter kits, ConnectSoft E-Mail Connection, Delrina WinFax & COMit LITE, SystemSoft Card & Socket Services, Puma TranXit, OAG FlightDisk, Intel Indeo, Microsoft RunTime Video for Windows and News Electronic Data-Taxi^{San Francisco Edition}
- 3 year manufacturer's warranty



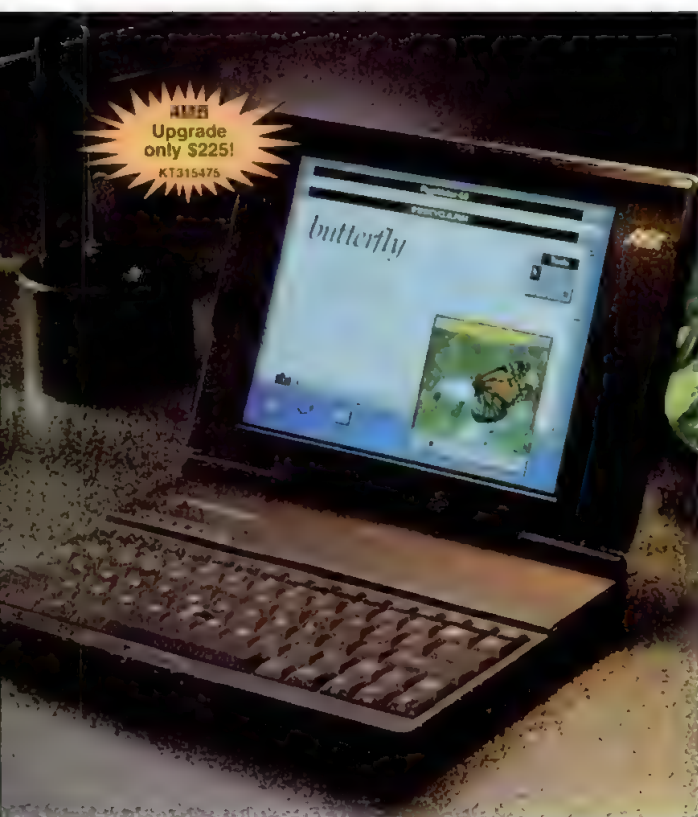
8MB Upgrade only \$429! KTAS950NB

\$4,719

Ascentia 950N, Pentium® 75MHz 8MB RAM, 800MB HDD 501708-301

AST Ascentia 950N Notebooks

Processor	Screen	RAM/HDD	Prod. Code	Price
Pentium® 75MHz	10.4" Dual Scan Color	8MB/500MB	501707-201	\$3,269
Pentium® 75MHz	10.4" Dual Scan Color	8MB/800MB	501707-301	3,549
Pentium® 75MHz	10.4" Dual Scan Color	8MB/1.2GB	501707-401	4,015
Pentium® 75MHz	10.4" Active Color	8MB/800MB	501708-301	4,719
Pentium® 75MHz	10.4" Active Color	8MB/1.2GB	501708-401	5,189



8MB Upgrade only \$225! KT315475

Ascentia 910N

Superior mobile computing with extraordinary lithium ion battery life

- 486DX4/75 processor
- 10.3" dual scan or 10.4" active color
- 8MB RAM expandable to 32MB
- Up to 700MB hard drive
- 2 Type II or 1 Type III PC Card slots
- Weighs only 6.5 pounds

Active Matrix Color!

\$3,129

Ascentia 910N 8MB RAM, 510MB HDD 501580-301

- Lithium Ion Battery
- Preinstalled software includes: MS-DOS, Windows, Windows® 95 Prodigy, America Online and CompuServe Starter Kits, Lotus Organizer, ConnectSoft E-Mail Connection Delrina WinFax & COMit LITE Traveling Software, LapLink Remote Access, SystemSoft Card & Socket Services, Flight OAG & News Electronic Data-Taxi^{San Francisco Edition}
- 3 year manufacturer's warranty

AST Ascentia 910N Notebooks

Processor	Screen	RAM/HDD	Prod. Code	Price
486DX4/75MHz	10.3" Dual Scan Color	8MB/510MB	501590-301	\$2,489
486DX4/75MHz	10.3" Dual Scan Color	8MB/700MB	501590-401	2,655
486DX4/75MHz	10.4" Active Color	8MB/510MB	501589-301	3,129
486DX4/75MHz	10.4" Active Color	8MB/700MB	501589-401	3,319



Protect your investment with a Targus carrying case on page 17.



800-488-0001

11

Notebooks



“This svelte portable dazzled us with a run-down time of nearly 8 hours—close to the best we’ve seen from any notebook computer.”

-PC World Magazine 4/95

All AST Notebooks include a 3 Year Manufacturer's Worldwide Warranty along with a 1 Year ExecCare® 48-Hour Turnaround Warranty Service!

*United States only

“When comparing AST, Compaq, Dell, IBM and Toshiba notebooks, which would we choose? AST's 910N. No question about it. Why? The price performance ratio.”

-Laptop Buyer's Guide and Handbook ("Big Brand Issue") 3/95



In Touch with Tomorrow TOSHIBA

Toshiba Tecra 700

Cutting edge technology for your most demanding computing needs

- 120MHz (2.9v) Pentium® processor
- 11.3" color display
- 8MB RAM (CS); 16MB RAM (CT)
- 1.13GB hard drive
- 4X CD-ROM drive
- 2 Stacked PC Card slots
- Stereo speakers
- Integrated 16-bit SoundBlaster Pro compatible audio
- Infrared port
- Lithium Ion Battery
- Optional multimedia PCI desk station with increased expansion capabilities
- True PCI Bus with PCI/ISA docking
- SelectBay supporting swappable FDD and 4X CD-ROM modules
- 3 year manufacturer's warranty



120MHz
Pentium®
Processor!

\$4,699 Tecra 700CS 11.3" dual scan 8MB RAM; 1.13GB HDD TA700CS

\$5,799 Tecra 700CT 11.3" active cfr 16MB RAM; 1.13GB HDD TA700CT

T2130CS and T2130CT Satellite® Series

Exceptional expandability in a portable package

Introducing Toshiba's newest group of affordable portable notebook computers—the Satellite T2130 Series. High performance computing is easy to afford and enjoy in the office and on the road. These new portables provide increased connectivity, a built-in power supply and a powerful 75MHz Intel DX4™ processor.

- 486DX4/75MHz processor
- 10.4" color display
- 8MB RAM, expandable to 32MB
- 500MB hard drive
- Accupoint™ integrated pointing device
- Integrated Power Supply, no AC adapter
- NiMH battery
- 2 Type II or 1 Type III PC Card slots
- 1 year manufacturer's warranty



\$2,439 486DX4/75MHz Processor 10.4" Dual Scan Color MAT2130CS

\$3,079 486DX4/75MHz Processor 10.4" Active Color MAT2130CT3

Satellite Pro™ 400CS and 400CDT

The ultimate in value and portability

The powerful 75MHz Pentium processor and 8MB EDO memory effortlessly give you the power you need to run complex graphics and advanced office applications, as well as many CD-ROM based titles for work and for home.

- 75MHz Pentium® processor
- 10.4" dual-scan color (CS), 10.4" active color display (CDT)
- 8MB RAM expandable to 40MB
- 772MB hard drive
- Toshiba 4X CD-ROM, optional (CS) integrated (CDT)
- MIDI, .WAV, and Sound Blaster Pro™ compatible sound
- 2 Type II or 1 Type III PC Card slots
- Lithium Ion battery
- Accupoint™ integrated pointing device
- 3 year manufacturer's warranty



28.8 PC Card
Fax Modem
only \$219
w/notebook purchase

\$3,515

400CS Pentium® 75MHz 10.4" Dual Scan Color MAT400CS7

Built-in
Quad Speed
CD-ROM
\$4,329

400CT Pentium® 75MHz 10.4" Active Color MAT400CT7

Toshiba Portégé™ 610CT

The award-winning standard in ultimate portability

The Portégé 610CT is built on an award-winning legacy of Toshiba technology and innovative features. It demonstrates Toshiba's engineering vision and ability to incorporate exceptional technologies which ensure you of the best performing, highest quality and most reliable ultraportable computer ever manufactured.



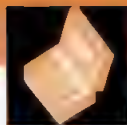
- 90MHz Pentium® processor
- 9.5" active color display
- 8MB RAM expandable to 40MB
- 686MB hard drive
- 2 Type II or 1 Type III PC Card slots

- Accupoint™ integrated pointing device
- 3 year manufacturer's warranty

\$4,399

Pentium® 90MHz 8MB RAM, 686MB HDD MAT610CT6





In Touch with Tomorrow TOSHIBA

NOTEWORTHY

PC Card Hard Disk Drive

High performance,
secure storage
solution

The Noteworthy Type III PC Card 260 offers data security and unlimited storage capacity for your PC Card compliant computer. The drive provides high performance in a light-weight, removable form factor specifically designed for rugged and reliable performance in demanding portable computing environments. The ideal solution for backing-up, transferring, or securing large volumes of data, and for the latest multimedia video and audio file storage needs. For all PC Card compliant notebook computers.



\$489

Type III PC Card 260
TA260MB

Port Replicators

Toshiba's Port Replicators provide easy, one-touch connection to your desktop environment making it easy to transition between stationary and mobile uses. It's the ideal way to easily connect to your desktop devices, such as printers, keyboards, external monitors, CD-ROMs and other such devices. You can leave all the devices plugged into the Toshiba Port Replicator and simply connect to the port replicator at the flip of a handle.

Both Port Replicators offer serial, parallel, PS/2 mouse and keyboard, DC In, and external SVGA video ports. In addition, the Portégé model has an FDD port.

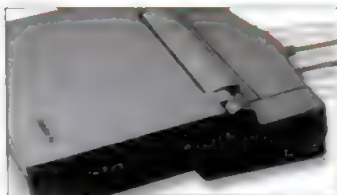
Satellite Pro 400 Series Enhanced Port Replicators

Supports the following ports: parallel, serial, video, PS/2 keyboard, PS/2 mouse, DC In, security lock slot, FDD, joystick, audio line-in, audio line-out, headphone and 2 Type III PC Card slots.

\$355

Satellite Pro 400 Series
Enhanced Port Replicator
TA400PORTH

T2100, T2110, T2130, T2150CD Port Replicator

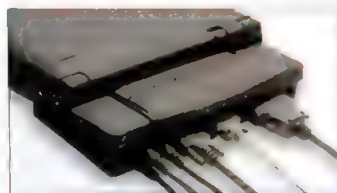


Works with all T2100 & T2150CD models.

\$269

Toshiba T2100, T2150CD
& T2130 Port Replicators
MATPA2708U

T3400, T3600CT Portégé Port Replicator



Works with all T3400 & T3600CT models.

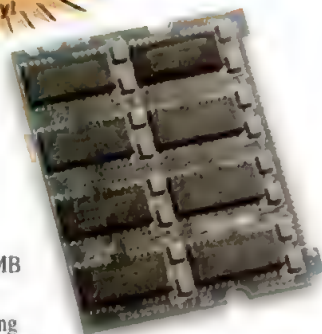
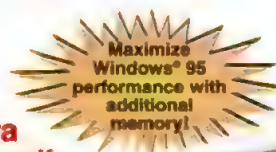
\$222

Toshiba T3400 & T3600CT
Port Replicators
MAT34PORTR

One for the
Office, One
for Home!

Get the extra RAM you need!

Are you needing more RAM to support your new Pentium® processors, high-powered software applications, sophisticated operating systems, multi-tasking capabilities or multi-media systems? Insight offers a complete list of 4MB, 8MB, 16MB, 24MB and 32MB memory cards and upgrade modules to take care of all your increasing memory requirements, and now at the lowest prices ever. By using Toshiba and Noteworthy brand memory you can rest assured that you are receiving the highest quality and the most reliable product. Each card has been completely tested to ensure full compatibility and reliability.



Memory Upgrade Modules

For T2100, T2105, T2150, T2110, T2125, T2130, T2135 and T2155 Series Notebook Computers

	Product Code	Price
4MB RAM	MATNW2026U	\$289
8MB RAM	MATNW2027U	579
16MB RAM	MATNW2028U	1,299
24MB RAM	MATNW2029U	1,999

For your Portégé 610CT and Satellite Pro 400 Series Notebook Computers

	Product Code	Price
8MB RAM	MATNW2031U	\$679
16MB RAM	MATNW2032U	1,249
32MB RAM	MATNW2034U	2,549

NewsCard Advanced Information Receiver

SkyTel

The revolution for personal communications is here! Imagine sending and receiving wireless and other information directly from your Toshiba portable computer. Now imagine the ability to reach virtually any site in North America. This amazing capability is now available with the new Noteworthy NewsCard Advanced Information Receiver. This new Type II PC Card enables portable computers running messaging software to receive and send (modem necessary to transmit) messages thru the SkyTel System. You can receive correspondence, stock quotes, news services, financial market reports, weather updates and other information through SkyTel Information Services. Users can also broadcast information to other NewsCard users virtually anywhere, anytime. The uses are virtually limitless.

For all PC Card compliant notebooks.

\$249

NewsCard Advanced
Information Receiver
MATNW502OL



Turn your new Toshiba Notebook PC into a true desktop replacement with these productivity enhancement accessories!



800-488-0001



TEXAS INSTRUMENTS

Windows 95
COMPATIBLE



pentium®

Plug and Play



NEW!
90MHz
Pentium

TravelMate 5000 Pentium® 75MHz

Superior Pentium® performance with extended battery life from dual lithium-ion batteries

- 75MHz Pentium® processor (3.3v)
- Choice of 10.5" dual scan color or 10.4" active color display
- 8MB RAM, expandable to 32MB
- 500MB or 772MB hard drive
- 2MB video memory
- PCI internal and external expansion bus
- Built-in 16-bit sound, speakers and microphone
- Serial infrared port
- 2 Type II or 1 Type III PC Card slots
- 2 Lithium Ion batteries, up to 6 hours
- Integrated "The Point" pointing device
- Weighs only 6.7 pounds
- 3 year manufacturer's warranty



\$4,079

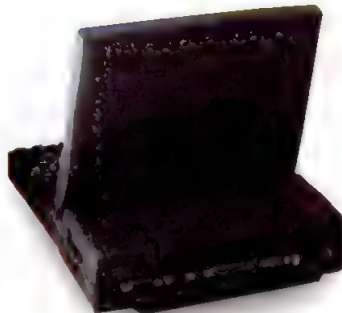
10.4" Active Matrix Color
8MB RAM, 772MB HDD
TEXTMPC77

\$2,999

10.4" Dual Scan Color
8MB RAM, 500MB HDD
TEXTMPC55

DockMate for 5000 & 5100 Series

The TravelMate 5000 & 5100 offer a docking system option for even greater convenience in desktop replacement applications. The DockMate has a serial and parallel port, with VGA, mouse and keyboard connections offering users one connection for the most popular interfaces.



\$255

DockMate for 5000 & 5100
TEXTMZDOCK

TravelMate 5100 Pentium® 90MHz Unsurpassed mobile computing power!

The leading Pentium desktop PCs have it—now you can get in a notebook. The TravelMate 5000 & 5100 are the first Pentium portables designed with an internal PCI bus architecture. Now instead of data trickling through the tiny ISA or EISA buses found in most Pentium portables, the TravelMate 5000 & 5100's new broad bandwidth PCI bus opens the floodgates so more information can flow through at much higher speeds. With the TravelMate 5000 Series you can work faster and smarter than ever before, with the ability to perform tasks simultaneously with no delays. For the lowest possible price on the best possible Pentium/PCI notebook, order yours from Insight today!

- 90MHz Pentium® processor
- 10.4" active matrix color display
- 8MB RAM, expandable to 32MB
- 1.2GB hard drive
- 2MB Video RAM
- PCI internal and external expansion bus (50MHz)
- Built-in 16-bit sound, speakers and microphone
- Serial infrared port
- 2 Type II or 1 Type III PC Card slots
- 2 Lithium Ion batteries, up to 6 hrs
- Integrated pointing device
- Weighs only 6.7 pounds
- 3 year manufacturer's warranty

\$4,669

10.4" Active Matrix Color
8MB RAM, 1.2GB HDD
TEXTP90CT

Panasonic
Office Automation

Panasonic PC Card Portable Double Speed CD-ROM Player

**Worldwide leader in
CD-ROM players**

- Connects to a notebook computer through a standard PC Type II card
- Connects to a desktop computer through a SCSI 2 interface
- 300KB/second transfer rate

- 295ms access time
- 128KB memory buffer
- Power Save feature
- Operates on 6 AA size batteries, or with supplied AC adapter
- Acts as an audio CD player too
- 2 year limited warranty

\$319

Panasonic PC Card Portable
Double Speed CD-ROM Player
ODPND720

Great for
Notebooks!



Insight is a
NASDAQ
traded company



**Maximize your notebooks power
by upgrading your memory—see
page 51 for details!**

TEXAS INSTRUMENTS



**Weights only
5 pounds!**

Extensa 450

**Lighter than a notebook—
more capable than a
subnotebook—more
affordable than both**

- 486DX4/75MHz processor
- 9.4" active matrix color (450T), or 10.4" dual scan color (450) display
- 4MB RAM expandable to 32MB
- Removable 340MB hard drive

- Type II PC Card slot
- Ergonomic keyboard and palmrest with TouchPad pointing device
- Parallel Serial Infrared, PS/2 and Expansion Interface (VGA, Serial and Second PS/2 Interfaces available through Port Enabler)
- NiMH battery
- Weighs only 5 pounds
- 1 year manufacturer's warranty

\$2,039

Extensa 450T
9.4" Active Matrix Color
TEXT450CT

\$1,799

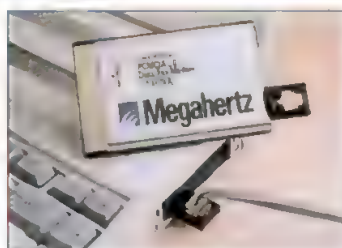
Extensa 450
10.4" Dual Scan Color
TEXT450CS

Megahertz

PC Card Fax/Modems with XJACK™

**Pops out of your modem
to hook directly to a
standard phone cord**

Megahertz Fax Modems with XJACK™ combine PC Card standards with Megahertz's patented XJACK™ connector for easy-to-install, credit card modems which hook directly to your phone jack. Megahertz's patented



XJACK™ (expandable jack) is the simplest, most practical connector available. The retractable RJ11 tray pops out for use and back in for travel, eliminating the need to carry external connectors.

**Three times
more rugged than
other PC Card
connectors!**

X-Jack 28.8/14.4

- PC Card Standard
- 28.8/14.4 data/fax modem

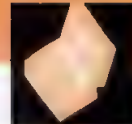
\$289

Megahertz X-Jack 28.8/14.4
MBXJ2288

Megahertz PC Card Fax/Modems w/XJACK™

Fax/Modem	Type	Product Code	Price
X-Jack 14.4/14.4	PC Card	MBXJ144100	\$169
X-Jack 14.4 Cellular Data/Fax	PC Card	MB4144MIT	189
X-Jack 14.4/14.4 Gold Series	PC Card	MBXJ2144	199
X-Jack 28.8/14.4	PC Card	MBXJ2288	289
Ethernet Combo 14.4/14.4	PC Card	MBXJ144ETH	349

Notebooks



Extensa 550

**The power of a pentium
processor for the price of a 486!**



pentium®

Now you can get the power of a Pentium processor for the price of the competition's 486. The TI Extensa 550 offers you the flexibility to grow. The floppy disk is removable and interchangeable with an extra lithium ion battery for longer battery life, or a CD-ROM module providing multimedia capabilities or access to large data files on CD ROMs. The 524MB hard drive is also removable to make it easy to upgrade to larger capacity drives.

- 75MHz Pentium® processor
- 10.4" color display
- 8MB RAM expandable to 40MB
- 524MB hard drive
- Built-in touchpad pointing device
- 2X CD-ROM (CD & CDD)
- 16-bit stereo sound (CD & CDD)
- Infrared serial port
- PCI bus architecture
- 1 year manufacturer's warranty

**Multimedia
on the go!**

\$2,499

Extensa 550 Pentium® 75
10.4" dual scan; 8/524MB
TEXT550CS

Texas Instruments Extensa 550 Models

Description	Screen	RAM/HDD	Prod. Code	Price
Pentium® 75	10.4" Dual Scan Color	8/524MB	TEXT550CS	\$2,499
Pentium® 75	10.4" Dual Scan Color	8/524MB w/CD	TEXT550CD	2,999
Pentium® 75	10.4" Active Color	8/524MB w/CD	TEXT550CDT	3,599



If you're going to run Windows 95 you'll probably want to upgrade your notebook's standard memory. See page 51 and call Insight for expert advice.



800-488-0001

15

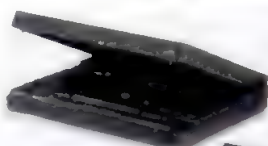


ThinkPad 701C/CS

Uncompromised, full featured computing power weighing only 4.5 lbs

- 486DX4/75MHz processor
- 10.4" color display
- 8MB RAM, expandable to 24MB
- Up to 540MB hard drive
- 2 Type II or 1 Type III PC card slots
- TrackWrite™ expandable full-size keyboard
- TrackPoint™ III integrated pointing device
- Built-in 14.4/14.4 data/fax modem
- Wireless infrared port
- Built-in 16-bit audio
- Super NiCd battery
- Weighs only 4.5 pounds
- 3 year manufacturer's warranty

- All ThinkPad 701's include the MultiPort II which features the following:
 - Mouse/Numpad connector (6-pin)
 - External keyboard connector (6-pin)
 - EPP parallel port (25-pin)
 - Serial connector (6-pin)
 - Audio line in (3.5 mm)
 - External display connector (15-pin)
 - DC input connector



\$2,449 486DX4/75, 10.4" Dual Scan Ctr
8MB RAM, 360MB HDD
IBT26302SU

IBM ThinkPad 701C/CS Models

Description	Screen	RAM/HDD	Prod. Code	Price
486DX4/75MHz	10.4" Dual Scan Color	8MB/360MB	IBT26302SU	\$2,449
486DX4/75MHz	10.4" Dual Scan Color	8MB/540MB	IBT26305SU	2,649
486DX4/75MHz	10.4" Dual Scan Color	8MB/720MB	IBT26307SU	3,025
486DX4/75MHz	10.4" Active Color	8MB/360MB	IBT26302TU	2,899
486DX4/75MHz	10.4" Active Color	8MB/540MB	IBT26305TU	3,159
486DX4/75MHz	10.4" Active Color	8MB/720MB	IBT26307TU	3,575



ThinkPad 755CX

Portable computing beyond the leading edge technology

- Pentium® 75MHz processor
- 10.4" active color display
- 8MB RAM, expandable to 40MB
- Up to 810MB hard drive
- SVGA 800 x 600 LCD
- 2 Type II or 1 Type III PC card slots
- Built-in 16-bit audio, microphone and speakers
- TrackPoint™ III integrated pointing device
- Built-in 14.4/14.4 data/fax modem
- Lithium ion battery
- 3 year manufacturer's warranty



\$4,849 Pentium® 75, 10.4" Active Ctr
8MB RAM, 540MB HDD
IBT26302SU



IBM ThinkPad 755CX Models

Description	Screen	RAM/HDD	Prod. Code	Price
Pentium® 75MHz	10.4" Active Color	8MB/540MB	IBT9545HBD	\$4,849
Pentium® 75MHz	10.4" Active Color	8MB/810MB	IBT9545HBE	5,249

The following software is preinstalled:

Microsoft Video for Windows™ 1.1
Runtime, Monologue for Windows,
Audiofile® TalkWorks™, Triton
CoSession™ Host, Lotus® Organizer™,
Lotus ScreenCam™, AlphaNet™
FollowFax™, SEDONA Systems
REPRINT™, Asymetrix® COMPEL™

Personal Edition, Lotus cc:Mail™ for the IBM Global Network®, SofNet FaxWorks Voice™, Puma TranXit™, PRODIGY®, America Online® for Windows®, Reuters Money® Network®, Taxi™, IBM PC Card Director, Online User's Guide and System Information.

* Limited subscription time and/or usage for applies to selected software titles



MOTOROLA



Motorola PC Cards

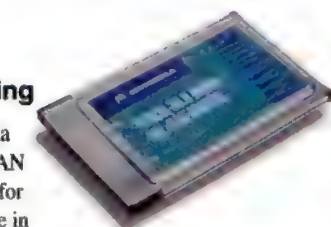
Description	Type	Data/Fax Rate	Product Code	Price
Lifestyle Cellular	PC Card	14.4/14.4	MBMOT14PLS	\$199
Lifestyle Wireline	PC Card	28.8/14.4	MBMOTLV34P	289
Power Cellular	PC Card	14.4/14.4	MBMOT14PPO	229
Marquis Combo	PC Card	28.8/14.4	MBMOTM28LP	499

PCMCIA 28.8, V.34/Ethernet Combo

The PC Card Connectivity King

The New Marquis PC Card from Motorola combines a high performance Ethernet LAN adapter with a powerful 28.8 modem/fax for screamin' fast connectivity whether you're in the office or on the road. An intelligent "installation engine" assures fast and easy installation on all leading portable computers.

- 28.8Kbps with true V.34 modulation Operation



\$499 Marquis ETH Combo
MBMOTM28LP



Fast, safe overnight delivery by FedEx.

FedEx

Federal Express



To complete your mobile office see pages 68, 69 and 72 for phone book and atlas software.



Display converts
into LCD overhead
projection panel!
(CV and CDV Models)

ThinkPad 755CD/CV/CDV

The ultimate portable presentation tool

If winning business or impressing audiences with persuasive presentations is the heart of what you do, the ThinkPad 755CD, CV & CDV series notebooks will be the one tool you can't work without. Leading-edge technology and advanced function come together in these powerful notebooks that once again puts IBM at the vanguard of design and innovation.

Now you can take your most sophisticated sales and training presentations anywhere you need, without taking along any extra equipment. That's because the ThinkPad 755CD/CV/CDV notebooks are a ready-to-go, full-function multimedia machines right out of the box.

- Up to 75MHz Pentium® processor
- 10.4" active color display
- 8MB RAM, expandable to 40MB
- Up to 1.2GB hard drive
- 2 Type II or 1 Type III PC card slots
- 2X CD-ROM drive (CD & CDV)
- Built-in 16-bit audio, microphone and speakers

4MB
Upgrade
only \$259!
KT260377



\$4,749

486DX4/100, 10.4" Active Cr
8MB RAM, 540MB HDD
IBA95459BD

- TrackPoint™ III integrated pointing device
- Built-in 14.4/14.4 data/fax modem
- NiMH battery
- Weights only 7.3 pounds
- 3 year manufacturer's warranty

IBM ThinkPad 755CD/CDV & CV Models

Processor	Screen	RAM/HDD	Prod. Code	Price
755CD 486DX4/100	10.4" Active Color	8MB/540MB	IBA95459BD	\$4,749
755CD 486DX4/100	10.4" Active Color	8MB/810MB	IBA95459BE	5,149
755CDV 486DX4/100	10.4" Active Color	8MB/810MB	IBT9545ABK	6,349
755CV 486DX4/100	10.4" Active Color	8MB/540MB	IBT95458BJ	5,249
Pentium® 75MHz	10.4" Active Color	8MB/810MB	IBT9545FBK	5,449
Pentium® 75MHz	10.4" Active Color	8MB/1.2GB	IBT9545FBL	5,899



Notebook Carrying Cases

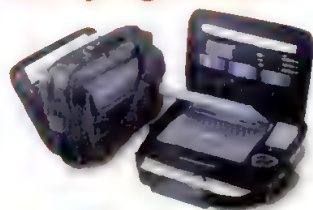


Notepac

- Fully-padded computer section
- Workstation area for disks, pens, files and business cards
- Also holds AC adapter, cables and external keyboards or modems

\$39

Notepac
NB562153



Leather Case

- Luxurious full-grain cowhide outer-shell
- Expanding file with three divided sections
- Deluxe shoulder strap

\$89

Leather Notebook Case
NB89372

Notebooks



8MB
Upgrade
only \$479!
KT260378

ThinkPad 755CE/CSE

Your complete portable computing solution that includes a built-in modem and communications package that keeps you connected wherever business takes you

If you're serious about using advanced technology and mobile computing to gain a competitive edge in your business, then you owe it to yourself to give IBM ThinkPad® 755CE/CSE notebook computers some serious consideration.



Shows with optional Dock II

The power and memory to zip through your most demanding applications. Displays that are among the biggest and brightest available today on a notebook. Storage with very large, removable hard-disk drives. IBM's built-in TrackPoint™ pointing device. PC Card slots. Industry leading battery performance. All in a sleek, lightweight, elegant notebook. And since your ThinkPad notebook comes with an unprecedented selection of personal productivity software programs preinstalled, you can get to work right away.

- 486DX4/100MHz processor
- 10.4" color display
- 8MB RAM, expandable to 40MB
- Up to 810MB hard drive
- 2 Type II or 1 Type III PC card slots
- Built-in 5.25" 2X CD-ROM drive
- Built-in 16-bit audio, microphone and speakers

- TrackPoint™ III integrated pointing device
- Built-in 14.4/14.4 data/fax modem
- NiMH battery
- Weights only 6.4 pounds
- 3 year manufacturer's warranty

\$3,849

486DX4/100, 10.4" Dual Scan Cr
8MB RAM, 540MB HDD
IBA95456BD

IBM ThinkPad 755CE/CSE Models

Processor	Screen	RAM/HDD	Prod. Code	Price
755CSE 486DX4/100	10.4" Dual Scan	8MB/540MB	IBA95456BD	\$3,849
755CSE 486DX4/100	10.4" Dual Scan	8MB/810MB	IBA95456BE	4,299
755CE 486DX4/100	10.4" Active Color	8MB/540MB	IBA95457BD	4,649
755CE 486DX4/100	10.4" Active Color	8MB/810MB	IBA95457BE	5,099



The Universal Notebook Case

- Durable, synthetic leather outer-shell
- Separate expanding file section
- Detachable shoulder strap w/cushioned pad
- Adjustable padded dividers
- Two external document pockets
- Disk pockets, pen and business card holders



\$69

Universal Notebook Case
NB892001



800-488-0001

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HEWLETT® PACKARD

Hewlett-Packard Omnibook 600C Series features:

The HP Omnibook 600 notebook PC offers high performance, durability, and convenience for the professional who frequently needs a PC for use on the go.

- Up to 486DX4/75MHz processor
- 8.5" dual scan color display
- 4MB or 8MB RAM expandable to 20MB
- 170MB or 260MB hard drive
- 1 Type II or 2 Type III PC Card slots
- Pop-up Mouse
- Ext. 1.44MB floppy drive
- Weighs only 3.8 pounds
- NiMH Battery
- 3 year manufacturer's warranty


\$3,129

HP Omnibook 600CT
8.5" Active Color; 8/260MB
HPOB675CT2

**4MB
Upgrade
only \$245!**

KT353034

Omnibook 600C Ultra-Portable Notebooks

Processor	Screen	RAM/HDD	Prod. Code	Price
486DX2/50MHz	8.5" Dual Scan Color	4MB/260MB	HPOB650CS2	\$2,189
486DX4/75MHz	8.5" Dual Scan Color	8MB/260MB	HPOB675CS2	2,599
486DX4/75MHz	8.5" Active Color	8MB/260MB	HPOB675CT2	3,129

NEC

NEC Versa 2000 Series

On-the-road connectivity with strong performance features

The new Versa 2000 Series of notebook computers delivers not only attractive pricing but brilliant displays, state-of-the-art lithium ion battery, fine-tuned performance and, most importantly, the best value in notebook computing today!

- 486DX4/75 processor
- Up to 10.4" color display
- 4MB or 8MB RAM
- 340MB or 540MB hard drive
- 2 Type II or 1 Type III PC card slots
- Integrated 14.4/14.4 data/fax modem (Versa 2000C Models)
- Lithium Ion battery
- Weighs only 6.3 pounds
- 1 year manufacturer's warranty


\$2,539

Versa 2000C 486DX4/75MHz
8MB RAM, 350MB HDD
NCV275CT3

**4MB
Upgrade
only \$195!**

KT353010

NEC Versa 2000 Notebooks

Model	Processor	Screen	RAM/HDD	Prod. Code	Price
2000D	486DX4/75MHz	10.4" Dual Scan	4MB/350MB	NCV275CS3	\$1,955
2000C	486DX4/75MHz	9.5" Active Clr	8MB/350MB	NCV275CT3	2,539
2000C	486DX4/75MHz	9.5" Active Clr	8MB/540MB	NCV275CT5	2,735



NEW MEDIA

Experts In Portable Computing Solutions

**100% hot
swappable!**



Fax Modem PC Card 28.8kbps Fax/Modem

Includes WinFax, WinCom Lite and a lifetime warranty.

\$219

28.8 Fax/Modem
with purchase of a notebook
NMC00517

New Media PC Card Fax/Modems

Description	Type	Data/Fax	Product Code	Price
14.4 (with Notebook Purchase)	PC Card	14.4/14.4	NMC00533	\$99
14.4 Fax/Modem	PC Card	14.4/14.4	NMC00360	129
28.8 Fax/Modem (w/Notebook)	PC Card	28.8/14.4	NMC00517	219
28.8 Fax/Modem	PC Card	28.8/14.4	NMC00492	239
Snd Crds/SCSI Adptrs	Type		Product Code	Price
Bus Toaster SCSI2	PC Card		NMC00203	\$229
.WAVjammer Sound Card	PC Card		MMNMC00166	249
Sound SCSI2 COMBO	PC Card		NMC00436	419
Ethernet Ntwrk Adptrs	Type		Product Code	Price
Ethernet 10 BASE 2	PC Card		NMC00216	\$149
Ethernet COMBO	PC Card		NMC00497	159



EPSON®

Epson ActionNote™ 10C Model

revolution in notebook
power, value and versatility

From the easy to use fingertip touchpad, the speed and power of the 100MHz Cyrix® 5x86 processor, the ActionNote 10C Series is revolutionary. It combines cutting edge performance, no-compromises list of features, and incredible value. The remarkable ActionPoint touchpad is today's most advanced pointing device requiring only the tip of your finger to navigate. The 5x86 microprocessor with built-in Level 2 cache runs at 100MHz at just 3.3 volts, so you get blazing performance without sacrificing energy efficiency.

Cyrix 5x86 100MHz processor
10.4" dual scan color display
8MB RAM expandable to 24MB
810MB removable hard drive
Built-in ActionPoint™ Trackpad
Infrared wireless connectivity
Multimedia capable, with
integrated 16-bit stereo audio
2 Type II or 1 Type III PC Card slots
24-hour replacement warranty and
Global Care International Service



\$2,899 Epson ActionNote™ 910C
10MB HDD, 10.4" Dual Scan Ctr
EPSA910CS8

Notebooks



Epson ActionNote™ 890 Series

Portable computing tools
designed for your budget

- 486DX4/100MHz processor
- 10.4" color display
- 8MB RAM expandable to 24MB
- 540MB removable hard drive
- Built-in ActionPoint™ Trackpad
- Built-in 14.4kbps data/fax modem (895C & 895CX models)
- Multimedia capable, with integrated 16-bit stereo audio
- 2 Type II or 1 Type III PC card slots
- 24-hour replacement warranty and Global Care International Service



\$1,599 Epson ActionNote™ 895CX
540MB HDD, 10.4" Active Color
EPSA895CT5



Epson Notebooks

Model	Description	Screen	RAM/HDD	Prod. Code	Price
890C	486DX4/100MHz	10.4" Dual Scan	8MB/540MB	EPSA890CS5	\$1,999
890CX	486DX4/100MHz	10.4" Active	8MB/540MB	EPSA890CT5	2,399
895C	486DX4/100MHz	10.4" Dual Scan	8MB/540MB	EPSA895CS5	2,229
895CX	486DX4/100MHz	10.4" Active	8MB/540MB	EPSA895CT5	1,599

SONY®

Magic Link™ Communicator

Easy "pen-computing" useability
Intuitive graphical user interface
Connects to your desktop computer
Built-in modem and PC card slot
Comes with Name Card File,
Datebook, Pocket Quicken®,
PenCell® Spreadsheet, and more!

- Control your Sony Trinitron® and Videoscope® with remote option
- Connect to America Online®, Prodigy®, CompuServe®, X.400 or the Internet
- Join SkyTel® wireless paging with optional Magic Link® pager card

\$399 MagicLink™ Communicator
SMLPIC1000



NEW!

Send Smart Messages

Facilitate various modes of communication: fax, e-mail, pager and infrared, with smart messaging that finds your party, delivers multiple messages to one recipient or one message to many.

Schedule and Manage Your Time

Never again be late for a meeting! Your PIC-1000 reminds you of your daily tasks, organizes appointments, displays your calendar, changes times, advises you of conflicts and updates your schedule.

Keep your Name Card File

Your Magic Link name card file is smart! It not only keeps pertinent names, addresses and numbers—it automatically updates as messages are received, and delivers information by family, friend, colleague, customer or other grouping.

Sony Magic Link Accessories

Description	Product Code	Price
Magic Link Keyboard	SMLKEYBD	\$99
Magic Link Telephone Headset	SMLHEAD	49
1MB SRAM Memory Card	SML1MB	149
Deluxe Leather Case	SMLCASE	69
Magic Connect (Windows)	SMLWIN	79
Magic Connect (MAC)	SMLMAC	79
Magic Link Pager Card	SMLPICPP1	249
Lithium Ion Battery	SMLLITH	59



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World Wide Web! <http://www.insight.com>



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Notebook Accessories

Kensington Expert Mouse®

Programmable Trackballs

The Kensington expert Mouse® programmable trackball combines smarter hardware and software to help you work faster and more efficiently. You can easily assign buttons to perform many repetitive tasks with only one click. And you can combine the commands you use most often in an easy-to-use pop-up menu, and then execute those commands with just a single click.

- Powerful programmable software
- Large ball
- Removable cable
- Stainless steel bearings
- Symmetrical design
- Comfortable buttons
- Optical technology



\$119

Expert Mouse
ICKENBUSM

MicroSaver® Security System

The MicroSaver Security System introduces a portable way to secure your valuable notebook and desktop computers, docking stations and peripherals. The MicroSaver Security System uses a unique security slot already built into your computer or peripheral. Wrap steel cable around an immovable object, then insert the MicroSaver locking device into the built-in security slot. To secure the lock, just turn the key.

Other features include:

- Strong, compact and lightweight
- A security standard—leading manufacturers are adding this security slot to their product
- Lifetime warranty



\$59

MicroSaver® Security
KEN64068

KENSINGTON

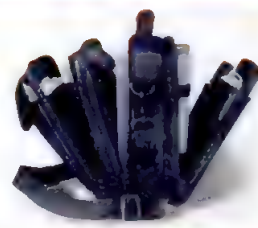


NoteBook Traveler PC Deluxe and Deluxe Cases

Similar in design, each Deluxe case can double as a briefcase. Inner storage compartments and pockets hold a variety of computer accessories and business supplies, from the Kensington NoteBook KeyPad, AC adapter and disks, to pens, pencils, sunglasses and car keys. 11" by 14" pocket holds file folders, manuals and reports. An outer back Quick Access™ pocket provides easy access to magazines and airline tickets.

\$79

NoteBook Traveler
NB64074



NoteBook Traveler Executive Case

The perfect briefcase, the Executive case features 3 separate, zippered compartments, including: padded computer compartment, second padded compartment with elastic straps (accommodates portable printer) and separate accordion-style file storage compartment. Also features expandable front pocket and Quick Access back pocket, numerous utility pouches, inner full-length compartment and adjustable accessory channel. Designed with the frequent traveler in mind.

\$119

NoteBook Traveler
NB64073



Notebook Computer Power Accessories



Xtend

Notebook Battery	Prod. Code	Price
IBM ThinkPad 355, 360	XTB306	\$139
Toshiba T4900, T4850, T2450, T2400, T1900	XTB403	139
Toshiba T2100, T2150, T2130, T2110	XTB496	139
TI TravelMate 4000M	XTB809	149
Epson ActionNote 866, 880, 890, 895	XTB908	149
Notebook Hypercharger/Conditioner	Prod. Code	Price
IBM ThinkPad 355, 360	XTC304	\$149
Toshiba T4900, T4850, T2450, T2400, T1900	XTC402	149
TI Travelmate 4000M	XTC812	149
Notebook DC Auto Adapter	Prod. Code	Price
IBM ThinkPad 355, 360	XTM301	\$99
Toshiba T4900, T4850, T2450, T2400, T1900	XTM401	99
TI TravelMate 4000M	XTM803	99



DATASONIX

Datasonix Pereos A 1GB mobile storage product

Datasonix Pereos™ is an external storage system for Windows and DOS computers capable of managing and storing from 1 gigabyte (GB) of data up to 100GBs or more. It weighs less than 10 ounces and stores the information on postage stamp-sized cartridges, each capable of holding up to 1.25GB of compressed data. Intuitive and powerful software tools make it easy use your information and applications.

- Plugs into standard parallel port
- 1.25GB cartridge capacity
- Up to 10MB/minute transfer rate
- 2-3/8" x 4" x 1-7/8" portable size

New!
A Gigabyte of Data
in the Palm of
Your Hand.



\$479

Datasonix Pereos
w/2 batteries, software & cartridge
TBPEREOS

Datasonix Supplies & Accessories

Product Description	Product Code	Price
A/C Adapter	TBPERADP	\$15
Data tape, single pack	TBDCPER	19
Pereos leather carrying case	TBPERCASE	25
Data tape, 2-pack with jewel case	TBDCPER2	45
Datasonix Pereos w/2 batteries & software	TBPEREOS	479

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Tell us what you think.
Call our Comment Line
toll-free at 800-359-2055.



Q There have been so many new technologies introduced for QIC tape backups recently, and now people claim that Travan is the standard. Is this true, and what is Travan technology?

A You're absolutely right. The tape backup market has been flooded with new technologies and it has even confused the experts.

QIC-80 has been the industry standard for several years now in the QIC (Quarter Inch Cartridge) tape backup market. The maximum capacity of a QIC cartridge is 250MB compressed. With the rapidly growing hard drive capacities, the QIC tape industry was in desperate need of a new standard.

The first solution introduced was the QIC-long technology. This simply extended the length of the tape. Changes had to be made to the hardware of the drive as well, and new capacities of 350MB, 700MB and 1400MB were suddenly available.

Next came the QIC-wide technology. The drive offered a faster backup rate. The tape is actually .33" in width. This allowed for capacities of 420MB, 850MB and 1700MB. QIC-wide seemed like a great solution, but there was one big problem – the QIC-wide drives couldn't read or write to QIC-80 or QIC-40 tapes.

So now, at last, the ultimate solution has been introduced. Travan Travan offers two drive capacities. The T-1 technology allows for 800MB capacity compressed. The T-3 allows for 3200MB compressed. They are available internally through your floppy controller, and externally through your parallel port. Each boast a backup rate of up to 10MB per minute.

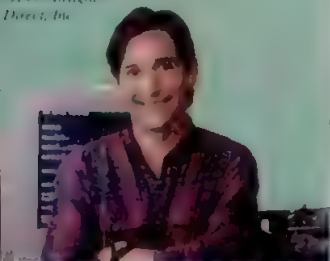
The best feature of the new Travan technology is its backward compatibility. The Travan drives will read and write your old QIC-80 cartridges. It will read and write QIC-long and QIC-wide too. Travan will even read the QIC-40 cartridges.

To answer your question – YES! Travan is the new standard in the QIC tape backup market. Check out our tape backup page for the details on Travan tape drives.

Write to Tech Talk! Send us your questions. Let our experts help YOU!
Tech Talk 1912 W. 4th St.
Tempe, AZ 85281

For an Auto-Response E-mail us on the Internet at info@insight.com or call our BBS at 602/902-5929.

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The winner again!

HARD DRIVES

International.

After 7 straight years, it's safe to say we're on a roll.

Insight, formerly Hard Drives International, has been chosen by the readers of *Computer Shopper* as "Best Buy" in hard drives an unprecedented seven years running! In addition, we are the only Direct Marketer of hard disk drives to win the *PC Magazine Editor's Choice Award*. Why gamble with the other guys?



June 27 1989
Mass Storage
Main Order



July 1993
Hard Disk
Upgrade

Your best bet!

No one knows hard drives like Insight. We have shipped more than a million hard drives. A company that prides itself on honesty and dependability, you can rest assured we'll be around long after the



Complete Kits!

DRIVE KITS INCLUDE

- ▼ Complete Mounting Kit, including:
 - 5 1/4" Mounting Frame
 - Rail Set
 - Data Cables
 - Screws
 - Jumper Blocks
 - Bezels
- ▼ HDI's Hard Drive Installation Guide with step-by-step installation instructions

competition has faded away. Why not let our friendly, knowledgeable sales staff help you select the drive that will provide you mass storage at the lowest price?

What a deal!

The other guys (from bare-bones operators to shopping warehouse behemoths), will gladly sell you a hard drive with little or no documentation. They assume you'll figure out how to install it. Not us. We "stack the odds" in your favor by including our own Hard Drive Installation Guide, a comprehensive manual that'll walk you through the process



WESTERN DIGITAL

Expert's Choice Drives



SCSI PCI Controllers!

- Fast Wide SCSI BUS host adapter
- See page 22 for complete details

WD7197\$339

Capacity**	Access	Form Factor/ Height	Manufacturer	RPM	Cache	Model	Base Kit	10-Min Kit
IDE								
545MB	14	3.5" 1"H	Seagate	3,811	120	ST3660A	\$179	\$229*
635MB	11	3.5" 1"H	Western Digital	4,500	64	WD2635A	189	239*
1080MB	10	3.5" 1"H	Fujitsu	5,400	256	FJ1606A	235	285*
1080MB	11	3.5" .75"H	Seagate	5,400	256	ST51080A	249	299*
1620MB	9	3.5" 1"H	Western Digital	5,200	128	WD31600A	369	419*
SCSI								
1080MB	10	3.5" 1"H	Fujitsu	5,400	256	FJ1606S	\$305	\$405
2100MB	8.9	3.5" HH	Fujitsu	7,200	512	FJ2915S	785	885
2147MB	8	3.5" 1"H	Seagate	7,200	512	ST32550W	1,025	N/A
4200MB	8.9	3.5" HH	Fujitsu	7,200	512	FJ2934W	1,105	N/A
4294MB	9	3.5" HH	Seagate	5,411	512	ST15230N	1,085	1,185
9100MB	12	5.25" FH	Micropolis	5,400	512	MC1991AV	2,285	2,385

*Bundled with GSI Model 21 EIDE Accelerator. **Capacities based upon mfg.'s quoted capacity where 1MB = 1,048,576 bytes.



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Hard Drives

WESTERN DIGITAL



Seagate

FUJITSU

Quantum

Maxtor

CONNER

IDE Hard Drives

Capacity**	Access	Form/Height	Interface	Cache	RPM	Model	Bare Kit	16 Bit Kit
635MB	11ms	3.5" 1"H	Enhanced IDE	64	4,500	WD2635A	\$189	\$239*
850MB	10ms	3.5" 1"H	Enhanced IDE	64	4,500	WD2850A	209	259*
1280MB	10ms	3.5" 1"H	Enhanced IDE	64	4,500	WD31200A	275	325*
1620MB	9ms	3.5" 1"H	Enhanced IDE	128	5,200	WD31600A	369	419*
545MB	14ms	3.5" 1"H	Fast-ATA	120	3,811	ST3660A	\$179	\$229*
854MB	11ms	3.5" .75"H	Fast-ATA-2	256	5,400	ST5850A	225	275*
1080MB	10.5ms	3.5" .75"H	Fast-ATA-2	256	5,400	ST51080A	249	299*
2140MB	10.5ms	3.5" 1"H	Fast-ATA-2	256	5,400	ST32140A	New Call for pricing	
2.5" Hard Drives								
524MB	16ms	2.5" 19MM	Fast-ATA	120	3,980	ST9655AG	\$409	N/A
810MB	16ms	2.5" 19MM	Fast-ATA-2	120	4,500	ST9816AG	New Call for pricing	
Seagate and the Seagate Logo are Registered Trademarks of Seagate Technology, Inc.								
540MB	10ms	3.5" 1"H	Fast-ATA-2	256	5,400	FJ1603A	\$169	\$189
1080MB	10ms	3.5" 1"H	Fast-ATA-2	256	5,400	FJ1606A	235	285*
544MB	12ms	3.5" 1"H	Fast-ATA-2	128	5,400	QUFB540A	\$185	\$235*
850MB	14ms	3.5" 1"H	Fast-ATA-2	128	4,500	QUFB850A	215	265*
1080MB	12ms	3.5" 1"H	Fast-ATA-2	128	5,400	QUFB1080A	245	295*
425MB	12ms	3.5" 1"H	Enhanced IDE	32	3,551	MX7425AV	\$159	\$179*
540MB	12ms	3.5" 1"H	Enhanced IDE	32	3,600	MX7540AV	180	230*
850MB	12ms	3.5" 1"H	Enhanced IDE	64	3,600	MX7850AV	205	255*
1260MB	12ms	3.5" 1"H	Enhanced IDE	256	4,500	MX71260AV	275	325*
1620MB	11ms	3.5" 1"H	Enhanced IDE	256	4,500	MX71626A	399	449*
425MB	14ms	3.5" 1"H	Enhanced IDE	32	3,600	CFS425A	\$155	\$175
540MB	14ms	3.5" 1"H	Enhanced IDE	32	3,600	CFS540A	175	225
850MB	14ms	3.5" 1"H	Enhanced IDE	32	3,600	CFS850A	209	259
1260MB	14ms	3.5" 1"H	Enhanced IDE	32	3,600	CFS1275A	259	309

*Bundled with GSI Model 21 EIDE Accelerator **Capacities based upon manufacturer's quoted capacity where 1MB = 1,048,756 bytes.

See the following pages for more hard drives!

SCSI Hard Drives

Capacity**	Access	Form/Height	Interface	Cache	RPM	Model	Bare Kit	16 Bit Kit
1050MB	9ms	3.5" 1"H	Fast SCSI-2 A/V	512	5,411	ST31230N	\$405	\$505
2147MB	9ms	3.5" 1"H	Fast SCSI-2 A/V	512	5,411	ST32430N	805	905
4294MB	9ms	3.5" HH	Fast SCSI-2 A/V	512	5,411	ST15230N	1,085	1,185
9090MB	11ms	5.25" FH	Fast SCSI-2 A/V	1,024	5,400	ST410800N	2,305	2,405
High Performance Barracuda Drives								
2147MB	8ms	3.5" 1"H	Fast SCSI-2 A/V	512	7,200	ST32550N	\$885	\$985
4294MB	8ms	3.5" HH	Fast SCSI-2 A/V	1,024	7,200	ST15150N	1,455	1,555
Seagate and the Seagate logo are registered trademarks. Barracuda and its logo are trademarks of Seagate Technology, Inc.								
1080MB	10ms	3.5" 1"H	Fast SCSI-2 A/V	256	5,400	FJ1606S	305	405
2100MB	8.9ms	3.5" HH	Fast SCSI-2 A/V	512	7,200	FJ2915S	785	885
4200MB	8.9ms	3.5" HH	Fast SCSI-2 A/V	512	7,200	FJ2934S	1,095	1,195
68 Pin Wide SCSI Drives								
2100MB	8.9ms	3.5" HH	Wide Fast SCSI-2 A/V	512	7,200	FJ2915W	\$805	N/A
4200MB	8.9ms	3.5" HH	Wide Fast SCSI-2 A/V	512	7,200	FJ2934W	1,105	N/A
2100MB	8.5ms	3.5" 1"H	Fast SCSI-2 A/V	512	7,200	MC4221AV	\$899	\$999
4300MB	8.5ms	3.5" HH	Fast SCSI-2 A/V	512	7,200	MC3243AV	1,229	1,329
9100MB	12ms	5.25" FH	Fast SCSI-2 A/V	512	5,400	MC1991AV	2,285	2,385
68 Pin Wide SCSI Drives								
2100MB	8.5ms	3.5" 1"H	Wide Fast SCSI-2 A/V	512	7,200	MC4221AVW	\$999	N/A
4300MB	8.5ms	3.5" HH	Wide Fast SCSI-2 A/V	512	7,200	MC3243AVW	1,389	N/A
9100MB	12ms	5.25" FH	Wide Fast SCSI-2 A/V	512	5,400	MC1991AVW	2,385	N/A
850MB	14ms	3.5" 1"H	Fast SCSI-2	128	4,500	QUTR850S	265	365
1080MB	12ms	3.5" 1"H	Fast SCSI-2	128	5,400	QUFB1080S	339	439
2216MB	8.5ms	3.5" 1"H	Fast SCSI-2	512	5,400	QUVP3221S	785	885
4280MB	8.5ms	3.5" HH	Fast SCSI-2	512	7,200	QUGP4280S	1,105	1,205
1080MB	11ms	3.5" 1"H	Fast SCSI-2	256	5,400	CFP1080S	\$405	\$505
2147MB	8.5ms	3.5" 1"H	Fast SCSI-2	512	7,200	CFP2107S	835	935
4294MB	9ms	3.5" HH	Fast SCSI-2	512	7,200	CFP4207S	1,155	1,255

**Capacities based upon manufacturer's quoted capacity where 1MB = 1,048,756 bytes

22

Trust the Mass Storage Experts!



For maximum hard drive performance make sure you have the latest technology controller. See pages 30 and 31.

Seagate

Seagate Hard Drives

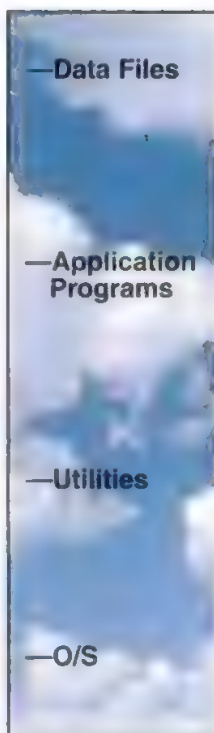
Seagate drives offer the capacity you need to optimize Windows® 95!

With the big splash being made about Windows 95, don't forget one important thing. When you upgrade, make sure you and your PC don't get swamped. Step up to a big, fast Seagate disc drive now.

The fact is that Windows 95 takes up 60% more disc space than Windows 3.1*. And you can bet that all your favorite applications rewritten for Windows 95 will also be bigger, to say nothing of the files you will create. But with a new Seagate drive, you're guaranteed to have all the capacity and performance you need to soak up all that this 32-bit, multi-tasking operating system demands.

The Seagate line of disc drives in capacities from 545MB to 9GB are perfect for Windows 95. With spindle speeds as high as 7200 RPM and transfer rates up to 16.6 MB/second and 20MB/second, Seagate ATA and SCSI drives provide the performance required by Windows 95. Seagate features a full line of drives designed and logo-certified for Windows 95. In fact, upgrading to a Seagate drive and Windows 95 with the appropriate RAM can improve your overall system performance by up to 60%.

*Source: PC Magazine, May 16, 1995

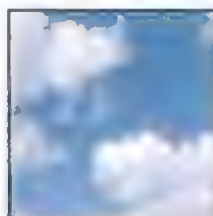


Windows 95's requirements



Windows 95 takes up 60% more disc space than Windows 3.1*

Make sure your hard drive measures up!



Your current hard drive's capacity

\$249

1GB IDE Hard Drive
10.5ms access time; 5,400 RPM
ST51080A



Capacity*	Access	Form/Height	Interface	Cache	RPM	Family	Model	Bare Kit	16 Bit Kit
IDE Drives									
545MB	14ms	3.5" 1"H	Fast-ATA	120	3,811	Medalist	ST3660A	\$179	\$229*
854MB	11ms	3.5" .75"H	Fast-ATA-2	256	5,400	Decathlon	ST5850A	225	275*
1080MB	10.5ms	3.5" .75"H	Fast-ATA-2	256	5,400	Medalist SL	ST51080A	249	299*
2140MB	10.5ms	3.5" 1"H	Fast-ATA-2	256	5,400	Medalist	ST32140A	New Call for pricing	
2.5" Hard Drives									
420MB	16ms	2.5" 12.7MM	Fast ATA-2	120	4,500	Marathon	ST9420AG	New Call for pricing	
524MB	16ms	2.5" 19MM	Fast ATA	120	3,980	Marathon	ST9655AG	399	N/A
810MB	16ms	2.5" 19MM	Fast ATA-2	120	4,500	Marathon	ST9816AG	New Call for pricing	
SCSI Drives									
1050MB	9ms	3.5" 1"H	Fast-SCSI-2 A/V	512	5,411	Hawk	ST31230N	\$409	\$505
2147MB	9ms	3.5" 1"H	Fast SCSI-2 A/V	512	5,411	Hawk	ST32430N	885	905
4294MB	9ms	3.5" HH	Fast SCSI-2 A/V	512	5,411	Hawk	ST15230N	1,085	1,185
9090MB	11ms	5.25" FH	Fast SCSI-2 A/V	1,024	5,400	Elite	ST410800N	2,305	2,405
High Performance Barracuda Drives									
2147MB	8ms	3.5" 1"H	Fast SCSI-2 A/V	512	7,200	Barracuda	ST32550N	885	985
4294MB	8ms	3.5" HH	Fast SCSI-2 A/V	1,024	7,200	Barracuda	ST15150N	1,455	1,555
68 Pin Wide SCSI Drives									
2134MB	8ms	3.5" HH	Fast Wide SCSI-2 A/V DHP	1,024	7,200	Barracuda	ST12450W	1,499	N/A
2147MB	8ms	3.5" 1"H	Fast Wide SCSI-2 A/V	1,024	7,200	Barracuda	ST32550W	1,019	N/A
4294MB	8ms	3.5" HH	Fast Wide SCSI-2 A/V	1,024	7,200	Barracuda	ST15150W	1,479	N/A

*Bundled with GSI model 21 EIDE accelerator. **Capacities based upon mfr's quoted capacity where 1MB = 1,048,576 bytes

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800-488-0001

23



Hard Drives

MICROPOLIS

Micropolis SCSI Hard Drives

Audio/Visual Drive Specialists

Nothing pushes the limits of disk drives like continuous video playback. Any gaps in data flow can cause frustrating jerky motion or even software crashes. A gap in writing a recordable CD-ROM will render the CD Master disc useless. That's why Micropolis created a line of disk drives designed specifically for multimedia, audio and video applications. Micropolis AV Gold Series drives provide the high, uninterrupted data rates required for digital media applications—so you'll never lose a field, frame or note. Maybe that's why more top AV professions specify Micropolis AV

Gold Series disk drives for their work. Available in 2.1, 4.3 and 9.1 GB capacities with either standard or wide SCSI-2 interfaces, Micropolis AV Gold Series disk drives carry a Five Year Warranty. So get the drive the AV industry trusts—the one that delivers every frame, every note, every time.

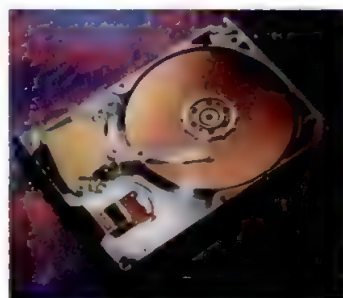


\$1,149

4GB SCSI Hard Drive
8.5ms access time; 7,200 RPM
MC3243S

Micropolis Hard Drives

Capacity	Access	Form/Hgt.	Interface	Cache	RPM	Product Code	Bare Kit	16 Bit Kit
2100MB	8.5ms	3.5" 1"H	Fast SCSI-2	512	7,200	MC4221S	\$849	\$949
4300MB	8.5ms	3.5" HH	Fast SCSI-2	512	7,200	MC3243S	1,149	1,249
9100MB	12ms	5.25" FH	Fast SCSI-2	512	5,400	MC1991	2,275	2,375
2100MB	8.5ms	3.5" 1"H	Fast SCSI-2 A/V	512	7,200	MC4221AV	899	999
4300MB	8.5ms	3.5" HH	Fast SCSI-2 A/V	512	7,200	MC3243AV	1,229	1,329
9100MB	12ms	5.25" FH	Fast SCSI-2 A/V	512	5,400	MC1991AV	2,285	2,385
68 Pin Wide SCSI Drives								
2100MB	8.5ms	3.5" 1"H	Wide Fast SCSI-2 A/V	512	7,200	MC4221AVW	\$999	N/A
4300MB	8.5ms	3.5" HH	Wide Fast SCSI-2 A/V	512	7,200	MC3243AVW	1,389	N/A
9100MB	12ms	5.25" FH	Wide Fast SCSI-2 A/V	512	5,400	MC1991AVW	2,385	N/A



\$245

1GB IDE Hard Drive
12ms access time; 5,400 RPM
QUFB1080A



\$1,099

4GB SCSI Hard Drive
8.5ms access; 7,200 RPM
QUGP4280S

Quantum®

Quantum Hard Drives

High quality, low price

Quantum Corporation, widely recognized as the mass storage industry's quality leader, supplies products worldwide for personal computers, notebook systems, workstations, high-end computers,

network servers and disk arrays. The company designs and manufactures products that enable system manufacturers and distributors to provide superior systems to their customers.

Quantum offers a wide variety of storage solutions, allowing customers to choose the exact combination of capabilities and features required.

Customer-focused innovations characterize all Quantum product lines. Projects begin with a thorough understanding of customer needs, followed by the selection of the most appropriate technology to meet those needs. The result is a family of innovative, customer-focused mass storage products matched to precise system performance requirements at the most popular capacity points.

Quantum Hard Drives

Capacity	Access	Form/Hgt.	Interface	Cache	RPM	Product Code	Bare Kit	16 Bit Kit
IDE Drives								
544MB	12ms	3.5" 1"H	Fast ATA-2	128	5,400	QUFB540A	\$185	\$235*
850MB	14ms	3.5" 1"H	Fast ATA-2	128	4,500	QUTR850A	215	265*
1080MB	12ms	3.5" 1"H	Fast ATA-2	128	5,400	QUFB1080A	245	295*
SCSI Drives								
540MB	12ms	3.5" 1"H	Fast SCSI-2**	128	5,400	QUFB540S	\$195	\$295
850MB	14ms	3.5" 1"H	Fast SCSI-2	128	4,500	QUTR850S	259	359
1080MB	12ms	3.5" 1"H	Fast SCSI-2**	128	5,400	QUFB1080S	335	435
2216MB	8.5ms	3.5" 1"H	Fast SCSI-2	512	5,400	QUVP3221S	779	879
2150MB	8.5ms	3.5" 1"H	Fast SCSI-2**	1,024	7,200	QUXP3125S	875	975
4280MB	8.5ms	3.5" HH	Fast SCSI-2	512	7,200	QUGP4280S	1,099	1,199

* Bundled with GSI model 21 EIDE accelerator. ** Fast SCSI-3 compatible.



Ask about our Same Day Delivery.





Insight is your Direct Source for Western Digital

WESTERN DIGITAL

Presenting Caviar High Performance Enhanced IDE Drives

Enhanced IDE offers performance and flexibility a step above Fast ATA

Everyone loves speed and performance. The only problem is that when it comes to drives, some people confuse one for the other. Some think time or the latest host transfer buzzwords like Mode 4 PIO represent a drive's performance. In actuality, a drive's performance is the combination of media rates, buffer sizes and host rates, as well as seek and spin times. So it hardly matters how impressive a drive's individual speed specs are if the other factors hamper its overall performance.

With our extensive expertise in engineering and manufacturing products for entire computer systems, Western Digital is far more committed to a drive's overall, "integrated" performance. This broader perspective enables us to optimize all the drive technologies, so we can deliver drives with the industry's best performance. So before someone tries to pull a fast one on you, remember: there's more to drives than speed alone.

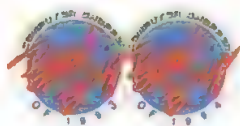
- Supports transfer rates up to 16.6MB per second and all Fast ATA transfers
- Allows drive sizes up to 8.4GB
- Up to 4 drives or other devices per system
- Support for future Enhanced IDE tape backups, CD ROMs, Optical Drives and more
- Fully backward compatible with IDE and Fast ATA drives



\$369

1.6GB IDE Hard Drive
9ms access time; 5,200 RPM
WD31600A

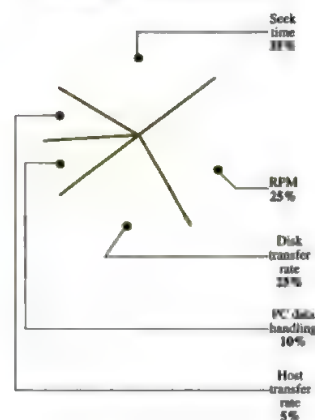
Western Digital-
Your solution for high performance
Enhanced IDE hard drives



1994-Caviar
100MB HDD



Relative influence of factors affecting drive performance.



Typical random I/O operation.

Western Digital Hard Drives

Capacity	Access	Form/Hgt.	Interface	Cache	RPM	Product Code	Bare Kit	16 Bit Kit
540MB	11ms	3.5" 1"H	Enhanced IDE	64	4,500	WD2540A	\$180	\$230*
635MB	11ms	3.5" 1"H	Enhanced IDE	64	4,500	WD2635A	189	239*
850MB	10ms	3.5" 1"H	Enhanced IDE	64	4,500	WD2850A	205	255*
1080MB	10ms	3.5" 1"H	Enhanced IDE	64	4,500	WD31000A	255	305*
1280MB	10ms	3.5" 1"H	Enhanced IDE	64	4,500	WD31200A**	275	325*
1620MB	9ms	3.5" 1"H	Enhanced IDE	128	5,200	WD31600A**	369	419*

*Bundled with GSI model 21 EIDE accelerator. **Experts Choice Drives



800-488-0001

25



FUJITSU

Fujitsu IDE & SCSI Hard Drives

Reliable, high-performance hard drives at soft prices!

Today's high-end computer systems absorb storage space at an incredible rate, thanks to the rapid growth of enterprise-wide networks and increasingly complex applications. Fortunately there's Fujitsu. The second largest computer company in the world offers you a full line of top quality hard drives to choose from. From as little as 530MB up to a whopping 4.2GB formatted capacity, all Fujitsu hard drives provide cost-effective storage solutions without ever sacrificing performance or reliability.

Call Insight today—we'll deliver your Fujitsu drive tomorrow.

Fujitsu Fast ATA-2 1GB IDE Drive

- 1080MB formatted capacity
- Fast 10ms average seek time
- Low-profile, one-inch-high design
- Fast 5,400 rpm spindle
- ATA-2 data transfer rate of 16.6MB/second
- Supports PIO mode 4 and DMA mode 2
- Supports CHS/LBA modes
- Advance caching (read/write)
- 256KB buffer
- Intelligent Power Management (Endergy Star Compliant)
- 300,000 hours MTBF

**1GB for
only \$235!**

\$235

1GB IDE Hard Drive
10ms access time; 5,400RPM
FJ1606A

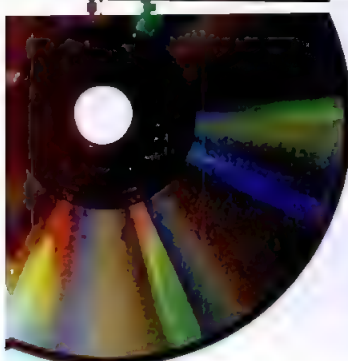


Fujitsu Hard Drives

Capacity	Access	Form/Hgt.	Interface	Cache	RPM	Product Code	Bare Kit	16 Bit Kit
IDE								
540MB	10ms	3.5" 1"H	Fast-ATA-2	256	5,400	FJ1603A	\$169	\$189
1080MB	10ms	3.5" 1"H	Fast-ATA-2	256	5,400	FJ1606A**	235	285*
SCSI								
540MB	10ms	3.5" 1"H	Fast SCSI-2 A/V	256	5,400	FJ1603S	\$195	\$295
1080MB	10ms	3.5" 1"H	Fast SCSI-2 A/V	256	5,400	FJ1606S**	305	405
2100MB	8.9ms	3.5" HH	Fast SCSI-2 A/V	512	7,200	FJ2915S**	785	885
4200MB	8.9ms	3.5" HH	Fast SCSI-2 A/V	512	7,200	FJ2934S	1,095	1,195
68 Pin Wide SCSI Drives								
2100MB	8.9ms	3.5" HH	Wide Fast SCSI-2 A/V	512	7,200	FJ2915W	\$805	N/A
4200MB	8.9ms	3.5" HH	Wide Fast SCSI-2 A/V	512	7,200	FJ2934W	1,105	N/A

*Bundled with GSI model 21 EIDE accelerator. **Expert Choice Drives





CD-ROM Drives



**Is it time to upgrade your CD-ROM drive?
Call your Insight sales representative today!**

CD-ROM Drives

Model	Speed	Transfer Rate	Access	Buffer	Interface	Int./Ext.	Product Code	Price
Plextor								
43CS	4X	600KB/S	170ms	256K	SCSI	Internal	ODTX4PLEX	\$319
4Plus	4.5X	675KB/S	130ms	256K	SCSI	Internal	ODTX4PLUS	339
43CH	4X	600KB/S	220ms	1024K	SCSI	Internal	ODTX43	399
45CS	4X	600KB/S	170ms	256K	SCSI	External	ODTX45PLEX	449
6PleX	6X	900KB/S	145ms	256K	SCSI	Internal	ODTX6PLEX	479
65PleX	6X	900KB/S	145ms	256K	SCSI	External	ODTX65PLEX	579
Sony								
55E	2X	300KB/S	250ms	256K	IDE	Internal	ODSO55EB	\$79
77E	4.5X	685KB/S	190ms	128K	IDE	Internal	ODSO77EB	149
76S	4X	600KB/S	190ms	256K	SCSI	Internal	ODSO76SB	219
Diskman	2X	300KB/S	295ms	128K	PCMCIA	External	ODSO150PRD	399
Toshiba								
3601	4.4X	660KB/S	150ms	256K	SCSI	Internal	ODTO3601	\$319
3601E	4.4X	660KB/S	150ms	256K	SCSI	External	ODTO3601E	439
T5302	4X	600KB/S	190ms	256K	IDE	Internal	ODTO5302	179
Teac								
CD55A	4X	600KB/S	195ms	256K	IDE	Internal	ODCD55AK	\$199
CD56A	6X	900KB/S	135ms	256K	IDE	Internal	ODCD56AK	299
NEC								
NC512	6X	900KB/S	145ms	256K	SCSI	Internal	ODNC512	\$399
NC602	6X	900KB/S	145ms	256K	SCSI	External	ODNC602	579
7 disc changer	4X	600KB/S	350ms	256K	SCSI	External	ODNCC302	359
Talon								
4 speed	4X	600KB/S	220ms	256K	IDE	Internal	ODMITK	\$149
Reveal								
CDQ100	4X	600KB/S	220ms	256K	IDE	Internal	RVCDQ100	\$179
Pioneer								
124X	4.4X	676KB/S	140ms	256K	SCSI	Internal	ODPNE124X	\$259
6 disc changer	4.4X	676KB/S	150ms	256K	SCSI	External	ODDRM624X	599
Panasonic								
D720 discman	2X	300KB/S	295ms	128K	PCMCIA	External	ODPND720	\$319
MicroSolutions								
Backpack	4X	600KB/S	250ms	128K	Parallel	External	ODMSBACK	\$399
Backpack w/sndcrd	4X	600KB/S	250ms	128K	Parallel	External	ODMSBACKS1	479



Add a sound card and speakers to your CD-ROM and you've built yourself a full scale multi-media system!



800-488-0001



CD-ROM Drives



Plextor 6PleX Internal SCSI CD-ROM Drive

"The fastest we've tested"

—Multimedia World

June 1995

In a move that solidifies its technological leadership, Plextor Corp., a pioneer in advanced technology for the CD-ROM marketplace, announced the world's first six speed, half-height CD-ROM drive.

Dubbed the 6PleX, this new drive line offers the fastest data throughput and access time available in CD-ROM performance with a 900KB/second

data transfer rate and a 145ms random access speed. The ideal positioning for the 6PleX is low CPU utilization allowing 30fps full screen video direct from CD-ROM.

- 900K throughput
- 145ms access time
- 256K buffer
- 100,000 MTBF
- 2 year manufacturer's warranty



\$479

6PLEX
ODTX6PLEX



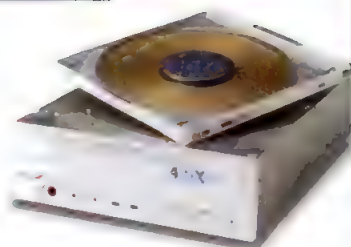
Only 9% CPU
utilization
when using Plextor drives

Windows
COMPATIBLE

Plextor 4PleX Plus
High performance
4X plug-and-play drive.
"The Plextor 4PleX Plus
is 5 stars all the way."
—Multimedia World's
All-Star Award

November 1995.

Following its Windows® 95 announcement of future SCAN compliant devices, Plextor Corp., a pioneer in advanced CD-ROM technology is releasing the 4PleX Plus, the world's first true Plug-and-Play CD-ROM drive. SCAM allows users to install peripheral devices into a computer without having to check or reset SCSI IDs. The 4PleX Plus is fully compatible with all major operating environments including Windows® 95.



- 675K data transfer rate
- 130ms random access
- 100ms seek time
- Drives feature full SCAM (SCSI Configured Auto Magically) capabilities
- Windows® 95 compatible
- 100,000 MTBF
- 2 year manufacturer's warranty

\$339

4Plex Plus
ODTX4PLUS

Plextor CD-ROM Towers

Description	Access	Dimensions	Interface	Weight	Trans.Rate	Buffer	MPC/2+Photo CD**	Prod. Code	Price
Quad 4 Drive/7 Bay Tower	170ms	8.25"x17"x12"	SCSI	17lbs.	600KB/sec	256K	Yes	ODTX4CS	2,499
Quad 7 Drive/7 Bay Tower	170ms	8.25"x17"x12"	SCSI	20lbs.	600KB/sec	256K	Yes	ODTX7CS	3,699
6PleX 4 Drive/7 Bay Tower	145ms	8.25"x17"x12"	SCSI	17lbs.	900KB/sec	256K	Yes	ODTX6TWR4	3,999
6PleX 7 Drive/7 Bay Tower	145ms	8.25"x17"x12"	SCSI	20lbs.	900MB/sec	256K	Yes	ODTX6TWR7	5,499

*MPC/2=MPC Level 2 Compliant

**Photo CD=Photo CD Capable

Access=Access Time/Trans. Rate=Transfer Rate

NEC

NEC MultiSpin® 4Xc External 7 Disc CD-ROM Changer

Get 4X speed plus fast
access to up to seven
CD-ROM discs

The MultiSpin® 4Xc 7 disc changer delivers quad-speed performance for incredibly smooth motion and fast access to data. Plus, you enjoy the convenience of having seven CDs loaded in your changer, ready to go.

\$359 NEC 4X External 7 Disc Changer
ODNCC302

NEC

Description	Int./Ext.	Product Code	Price
6-speed SCSI	Internal	ODNC512	\$399
6-speed SCSI	External	ODNC602	579
4-speed SCSI 7 Disc Changer	External	ODNCC302	359



7 Disk
Changer!

There are no clumsy caddies or magazines needed to load your changer. You can mix music and data discs together, and you can switch from one disc to another by simply clicking icons on your screen.

- 600K/second transfer rate
- 350ms access time
- 128K continuous flow cache
- PhotoCD™ compatible
- Volume controls and headphone jack
- 1 year manufacturer's warranty

SONY

Quad ATAPI/IDE CD-ROM

- 600K/second transfer rate
- 250 ms access time
- 256K buffer
- 100,000 MTBF
- Includes 16-bit IDE Controller

Low cost
SCSI available
too!



\$229 Quad-speed ATAPI IDE Drive Kit
ODS0760E

Sony

Description	Int./Ext.	Product Code	Price
IDE 55E-double speed	Internal	ODS055EB	\$79
ATAPI IDE 77E-4.5X speed	Internal	ODS077E	149
SCSI 190ms-quad speed	Internal	ODS076S	299
Diskman	Portable	ODPRD150	399
Diskman w/sound system	Portable	ODPRD150S	649
Quad for Mac/PC	External	ODS07611M	369
Recordable-double speed	Internal	ODS0920S	1,799
Recordable-double speed	External	ODS09211S	1,899

28

For immediate product information
just e-mail Insight at

Info@Insight.com

Insight

TALON MULTI MEDIA



**Quad
Speed!**

**Talon Quad-Speed
Drive Only \$149**



Hi-Val Wave Table Card

\$249 Talon Wave Kit
ODTAWAVE

Talon Quad Speed CD-ROM w/Wavetable and Speakers

Internal drive with 230ms access time, 256K buffer, 600KB transfer rate, photo CD compatible

- IDE/ATAPI interface
- 16-bit wave table card
- 4 Watts per channel
- MIDI interface/joystick port
- 100% SoundBlaster compatible
- Labtec 4 watt speakers

Talon			
Description	Int./Ext.	Product Code	Price
Bare Drive IDE/ATAPI	Internal	ODMITK	\$149
Super CD-ROM Kit IDE/ATAPI	Internal	ODTA4MK	229

PIONEER®

4.4x CD-ROM Internal Drive PNE-124X-SCSI

- 676KB transfer rate
- 140ms access time
- 100,000 HR MTBF
- 256K buffer

**4.4x
CD-ROM**

\$259 Model 124X
ODPNE124X



Pioneer

Description	Product Code	Price
4.4x CD-ROM Drive Internal PNE-124X-SCSI	ODPNE124X	\$259
DRM-624X, 6 disc Minichanger, Quad speed*	ODDRM624X	599
DRM-180X, 18 disc Minichanger, Quad speed*	ODDRM1804X	1,999

* External SCSI



Add a sound card and speakers to your CD-ROM and you've built yourself a full scale multi-media system!

CD-ROM Drives



In Touch with Tomorrow TOSHIBA



**PC
MAGAZINE
EDITORS'
CHOICE**

Model 3601

Internal Quad Speed, SCSI drive, 150ms access time, 660Kb/second transfer rate, photo CD, SCSI-2 interface and MPC II compliant. The model 3601 has a caddyless tray type electrical load/eject.

**New
Enhanced
Speed!**

\$319

Model 3601
ODTO3601

Toshiba

Description	Int./Ext.	Product Code	Price
Bare Drive, SCSI	Internal	ODTO3601	\$319
Kit, SCSI	Internal	ODTO3601K	399
3601, SCSI	External	ODTO3601E	439
5302 IDE Quad	Internal	ODTO5302	179

TEAC®

6X IDE CD-ROM Drive The fastest 6X CD-ROM Drive available



Meet the newest multimedia speed demon from TEAC—a six-speed CD-ROM drive featuring a 900KB/sec transfer rate and an incredible 110ms seek time! Now you can own the fastest drive to ever read a CD-ROM disk—and one of the most affordable with its new IDE/ATAPI interface.

- 16-bit IDE/ATAPI controller included
- SoundBlaster compatible
- 135ms access time

\$299

6X IDE CD-ROM
ODCD66AK

TEAC

Description	Int./Ext.	Product Code	Price
6X IDE CD-ROM drive kit	Internal	ODCD66AK	\$299
4X IDE CD-ROM drive kit	Internal	ODCD55AK	199



800-488-0001

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HDD Kits/Controllers

PROMISE TECHNOLOGY, INC.

Delivering the Promise of Storage Controller Performance

Promise Intelligent EIDE and SCSI Disk Controllers

Promise Technology, Inc., the creator and the leader of EIDE Disk accelerator technology brings a full line of high performance intelligent disk controller solutions that are recommended and certified by major drive manufacturers. All Promise disk controllers are uniquely designed with well matured Promise on board BIOS for higher capacity drive compatibility and ease of use. Drivers included for all major operating systems.

Promise Controllers

Model/Description	Product Code	Price
EIDEMAX 16-bit ISA EIDE, 4HDD/ATAPI, BIOS	PREIDEMAX	\$39
EIDE2300+ Controller, Fast I/O, 32-bit, 4HDD/ATAPI	PRDC2300+	59
EIDE4030+ Caching, 6 device/ATAPI, 16550, EPP/ECP	PRDC4030+	129
DC5030 IDE Caching, PCI 32-bit, Bus Master	PRDC5030	149
DC540 SCSI-2 PCI Fast Wide, Flash BIOS	PRDC540	199

POWERDrive® for Macintosh!

Your answer to high quality storage for your Macintosh. PowerDrives® are available in 245MB to 2.1 Gig capacities with internal or external kits.

Powerdrive Hard Drive Kits

Capacity	Brand	Drive Code	Internal	External
540MB	Fujitsu	FJ1603S+PD*	\$245	\$295
1080MB	Fujitsu	FJ1606S+PD*	355	405
2100MB	Fujitsu	FJ2915S+PD*	835	885
2216MB	Quantum	QUVP3221S+PD*	835	885
4280MB	Quantum	QUGP4280S+PD*	1,155	1,205



PS/2 Hard Drive Kits

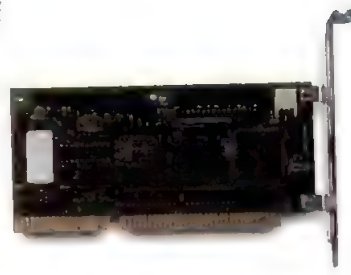
Need to upgrade your IBM PS/2 with a great storage solution? Insight has put together the complete kit for your IBM

PS/2 Model 50, 50z, 55, 60, 65, 70, 80 and 90. Kits include a Micro Channel controller, specific mounting brackets and the hardware you need for an easy installation. Listed below are just a few of the special deals you can enjoy on SCSI drive kits.

IBM PS/2 Hard Drive Kits

Capacity	Brand	Drive Code	Internal	External
530MB	Fujitsu	FJ1603S+MPS*	\$335	\$409
1080MB	Fujitsu	FJ1606S+MPS*	445	569
2100MB	Fujitsu	FJ2915S+MPS*	925	1,029
4294MB	Seagate	ST15150N+MPS*	1,675	1,745
9100MB	Micropolis	MC1991AV+MPS*	2,365	2,435

Insight is a
NASDAQ
traded company



GSi Enhanced IDE Boards Accelerate your data !

GSi Accelerator Boards provide the easiest and fastest way to integrate EIDE hard drives, floppy drives and tape backup units. These boards use a *Flash BIOS* to make installation simple and run IDE hard drives faster! These intelligent controllers require no device or system CMOS support.

GSi Enhanced IDE Accelerator Boards

Model/Adapter Description	Product Code	Price
11/8-bit 4-floppy & Tape Accelerator Board	GSIMODEL11	\$55
18/16-bit Enhanced IDE Accelerator Board	GSIMODEL18	39
21/16-bit Enhanced IDE, Flpy & Tp Acc Board	GSIMODEL21	49
32/16-bit Enhanced IDE, Flpy & I/O Acc Board	GSIMODEL32	109
4C/16-bit 4-Chan, 8-Enhanced IDE Acc Board	GSIMODEL4C	125
CD/16-bit ATAPI IDE CD-ROM Adapters for EIDE	GSIMODELCD	15
VI/32-bit VESA Extender (Single Channel)	GSIMODELV1	89
V2/32-bit VESA Extender (Dual Channel)	GSIMODELV2	139

Kingston TECHNOLOGY CORPORATION

Data Express Removable Frames and Carriers

The DE100i Data Express removable disk/tape drive subsystem consists of a rugged, removable drive carrier and mating receiving frame. The Kingston Data Express unit easily mounts internally into an available 5.25" half-height expansion bay in your PC or workstation. The DE100i carrier houses either a 3.5" SCSI or IDE device. A "Hot Swap" option allowing you to swap device carriers without powering down your system is available in SCSI, SCSI 2 and SCSI 3 versions of the Data Express. The Data Express DE100i features a device activity indicator light, a lighted ID select indicator LED, a drive carrier key lock and an unbeatable 5-year warranty. The DE100i is composed of rugged steel construction providing durability and the most efficient heat dissipation for today's high performance drives.



\$179

Data Express
KTDE100IS

- Provides ability to easily remove and transport data
- Easily mounts into any 5.25" half-height peripheral bay (1.7" high)
- Available for IDE and SCSI devices
- Available with "Hot Swap" option for SCSI devices to quickly insert and remove carriers without powering down your system
- 5 year manufacturer's warranty

FUTURE DOMAIN



Future Domain Controllers

Enhanced IDE Kits	Adapter	Bus	Product Code	Price
EIDE-CD	CD-ROM kit	ISA	FTEIDECD	\$29
EIDE-AT32VP	AT ValuePak	ISA	FTEIDEAT32	59
EIDE-AT42VP	AT Value Pak w/floppy	ISA	FTEIDEAT42	69
EIDE-VLVP	VL ValuePak	VLB	FTEIDEVL	79

Enhanced IDE Kits Powered by PowerIDE!™ for ISA Computer Systems

Run multiple Windows applications faster on all of your Enhanced IDE peripherals!

Future Domain offers the industry's most complete line of 16 and 32 bit Enhanced IDE controller kits compatible with ISA and VL systems! The company has always been committed to making the use of mass storage on PC's cost-effective "easy-to-do" experience. Future Domain's Enhanced IDE controllers and kits, like their SCSI products, are designed so that OEM's, distributors, VAR dealers and end-users can easily integrate Enhanced IDE peripherals into efficient, high-performance PCs—and at a cost that makes them a super value!

The Future Domain Enhanced IDE CD-ROM Kit contains everything you need to add IDE CD-ROMs to your ISA-bus PC! The Enhanced IDE CD-ROM Kit includes the Future Domain IDE-16002 controller, an MPC-2 audio cable, PowerIDE!™ software and complete documentation—all backed by our outstanding Customer Service Hot Line!

Each kit includes our amazing PowerIDE! software, a revolutionary breakthrough that allows PC users to gain all the benefits of Enhanced IDE performance and connectivity! PowerIDE! permits any application running in a DOS or Windows environment to work with any Enhanced IDE disk drive or other Enhanced IDE peripheral and efficiently manage their operation.

\$29

EIDE-CD Enhanced IDE Kit FTEIDECD



Recently received the "Network Computing" Editor's Choice Award!

QLogic Fast!SCSI

QLogic offers an entire family of high performance SCSI adapter cards for every application—from desktops and laptops to servers and workstations. Driver support for DOS/Windows, OS/2, Windows NT, SCO UNIX and Novell NetWare is included (except PC Card with DOS/Windows), as is toll-free technical support, a 5 year warranty, Core!SCSI for CD-ROM



and HDD. For servers there's the 12 MIPS RISC processor based Fast!SCSI IQ PCI card which offers 20MB/second SCSI-3 Workstations will want the RISC processor based Fast!SCSI IQ PCI-10 featuring 10MB/second All QLogic PCI cards come with free Core!SCSI VERSION 2 (Core!SCSI for CD-ROM and hard drives with PCI Basic card).

QLogic Fast!SCSI Adapters w/Core! Software

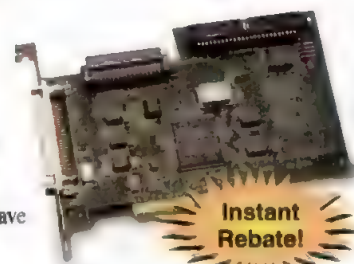
Model	Adapter	Bus	Prod. Code	Price
Basic I	SCSI 16 bit w/Core!	ISA	QLFSBASICI	\$45
ISA FL	SCSI2F 16 bit w/Core!	ISA	QLFSISA/FL	129
VESA FL	SCSI2F 32 bit w/Core!	VLB	QLFSVL/F	199
EISA FL	EISA SCSI2F w/Core!	EISA	QLFSEISA/F	219
PCI Basic	SCSI2 32 bit Basic w/Core!	PCI	QLFPCIBASC	129
PCI WIDE	SCSI2 32 bit w/Core!	PCI	QLFSPCI	299
PCI 10MBPS	SCSI2 32 bit w/Core!	PCI	QLFPCI-10	219
PC Card-10	Type 1 w/Core!	PC Card	QLPCMCI10	199



WESTERN DIGITAL

WD SCSI Controllers

Discover simplified SCSI at its best with the new Western Digital High Performance RISC based SCSI boards. These boards offer:



Instant Rebate!

- **Guaranteed Compatibility.** If you have an issue in the first 30 days we will make it right or refund your money
- **Automatic Termination.** Our SCSI boards are the only SCSI boards which do not require software or hardware termination
- **Flash Upgradeable BIOS.** Our BIOS can be upgraded in less than 10 seconds without opening the system, making future upgrades a breeze
- **Selectable Boot Drive.** Allows any SCSI or IDE drive to be the boot drive
- **Fast Performance.** Our SCSI boards perform up to 24% faster than competitors
- **Free Full Version of Core!** This allows support for any peripheral imaginable
- **5 Year Warranty and Free Technical Support.** We back our product with a full 5 year warranty and free lifetime technical support

Western Digital

Model	Adapter	BUS	Prod. Code	Price
WD7193	32 bit PCI to Fast SCSI-2	PCI	WD7193	\$219
WD7197	32 bit PCI to Fast Wide SCSI-3	PCI	WD7197	279
WD7296	32 bit PCI to Fast Wide SCSI-3 w/RISC Mem.	PCI	WD7296	299



Before you move to Windows® 95 be sure to back-up your data on Ditto. See page 34!



800-488-0001

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Removable Storage

Adaptec

High Performance Host Adapters



AHA® 3940W PCI-to-Wide SCSI Multichannel Kit

Provides exceptional performance and flexibility for demanding server requirements. Identical to the AHA-3940 except for these unique features.

- Supports 8-bit and 16-bit devices

Works great
with all SCSI
devices!

- Delivers up to 40MB/second data throughput across multiple SCSI channels in a single PCI slot
- Supports up to 30 devices per host adapter conserving valuable PCI slots

\$529

3940W SCSI-3 Wide PCI
No Flop 32 bit Busmaster Kit
AD3940WKIT

Adaptec

Product Description	Product Code	Price
1505 SCSI-2F Kit ISA No Flop 16-bit (Total CD Kit)	AD1505KIT	\$599
1522A SCSI-2F Kit ISA 16-bit 2 Flop	AD1522AKIT	1499
1530P SCSI-2F Kit ISA 16-bit No Flop (Win 95 PNP)	AD1530PKIT	1799
1640 Kit SCSI-2F MCA No Flop 16-bit Bus Master	AD1640KIT	3399
2742AT SCSI-2F Kit EISA 2 Flop 32-bit Twin Channel	AD2742ATK	3999
2742W SCSI-3F Wide EISA 2 Flop 32-bit Busmaster Kit	AD2742WKIT	4299
2825VL SCSI-2F/EIDE Kit 32-bit 2 Flop VLB	AD2825KIT	1899
2842A SCSI-2F Kit VLB 32-bit 2 Flop Busmaster	AD2842AKIT	2599
2940 SCSI-2F Kit PCI No Flop 32-bit Busmaster	AD2940KIT	2899
2940W SCSI-3 Wide PCI No Flop 32-bit Busmaster Kit	AD2940WKIT	3199
APA-358 SCSI Kit PARA Parallel to SCSI Enhanced Port	AD358KIT	1399
3940W SCSI-3 Wide PCI No Flop 32-bit Busmaster Kit	AD3940WKIT	5299
3985 SCSI-2F RAID PCI No Flop 32-bit Busmaster Kit	AD3985KIT	7899

FUJITSU *DynaMo* MO 230

New
Lower
Prices!



Fujitsu DynaMo Drives

- Includes two 230MB cartridges!
- Unlimited storage—simply add cartridges as your need increases
- 230MB cartridges \$39
- Easy to use—just like a floppy
- Fast 30ms seek time
- 100% reliable—100% reusable
- Read/write cache for improved access time
- 2.1MB/second data transfer
- SCSI-2

\$519

PC, External DynaMo
w/Controller and 1 Cartridge
ODFJ2512PC

Windows
COMPATIBLE

Fujitsu DynaMo Drives

Description	Product Code	Price
PC, External Parallel Port DynaMo w/1 Cartridge	ODFJ2512PT	\$449
PC, Internal DynaMo w/1 Cartridge	ODFJ2512AB	469
MAC, External DynaMo w/1 Cartridge	ODFJ2512M	499
PC, External w/1 Cartridge (incl. SCSI Controller)	ODFJ2512PC	519
Accessories	Product Code	Price
1-230MB Cartridge	OD3590545	\$39
5-230MB Cartridges	OD3590545K	159

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Charge it! We accept
all major credit cards.



Pinnacle MICRO THE OPTICAL STORAGE COMPANY

Pinnacle Apex 4.6GB Optical Hard Drive

The only two advantages magnetic hard drives held over optical drives have now been eliminated. In both price and performance, the new Pinnacle Apex 4.6GB is the first optical drive to beat magnetic hard drives.

- Faster than average hard drive with throughput of 6MB/sec max)
- Removable disks allow easy portability and security
- Unlimited capacity—just add another disk
- Comes with 1 cartridge
- 4.6GB capacity per disk
- Direct Overwrite media (one-pass)

\$1,695

Apex 4.6GB
External Optical Drive
ODPNAPEXE



Pinnacle Micro Optical Products

Product Description	Product Code	Price
Recordable CD-ROM Drives		
Internal PC Kit	ODPNRCDI	\$1,299
External PC Kit	ODPNRCDE	1,499



SyQuest *EZ Drive*

EZ-135 Fast Removable External Storage Drive



Internal drive and cartridges also available

Hard drives fill up; it's their nature and buying a new one each time they're full is very expensive. The search is over for affordable, safe, removable storage!

- 135MB capacity
- 13.5ms seek time
- 2.4MB/second transfer rate

\$229

EZ-135 External Drive
SYEZ135EXT

Internal Drive SYEZ135 for \$199



Look for the new Travan technology. It's a QIC tape backup device that can double a cartridges capacity through safe data compression.

Save data, save HD space, save money

Hard drives keep getting bigger and bigger—and that means you have more data to lose if something goes wrong. Don't risk it! And backing up your hard drive can provide a great bonus: more free space on your hard drive for your application software. Insight stocks a wide range of high-quality, affordable tape backup systems in both QIC and DAT format.

QIC (quarter-inch cartridge)

The most affordable and the best choice for many individual system owners. They're easy to install, provide reliable data storage, and unlike your hard drive, they never run out of room—just purchase additional tapes.

DAT (digital audio tape)

Up to 8GB of storage on a single tape makes this a good choice for network-wide backups or for a single system's large hard drive. DAT tape backup units are typically faster than QIC and offer the added convenience of unattended backup.

Talon 350MB Internal QIC Tape Backup

- Attaches to existing floppy controller
- 2-3MB/minute, w/ data compression.

\$119

350MB Internal QIC Tape Backup—2 tapes included
TBTA350IK2

Talon 4GB Internal SCSI DAT Drive

- 15MB/minute backup rate
- Includes mounting rails, cables and software

\$849

4GB Internal DAT Drive
TBTA1536B

Hewlett-Packard Colorado T1000

Travan—introducing a new technology from the world leader in tape storage!

The 800MB Travan Tape Drive is the new standard in data protection featuring reliable high capacity mini cartridge storage, full QIC-80 (read and write) and QIC-40 (read) compatibility with millions of existing tape drives.

\$179

HP Colorado T1000 w/1 cartridge
COHPT1000X

Tape Backup



700MB for \$119!

Talon Tape Backups

QIC Tape Backups	Interface	Product Code	Price
350MB Internal w/2 Cartridges	Floppy	TBTA350IK2	\$119
1.4GB Internal w/1 Cartridges	Floppy	TBTA1400IK	269
DAT Tape Backups	Interface	Product Code	Price
2GB Int. w/mntng rails, cables & software	SCSI	TBTA1534B	\$749
4GB Int. w/mntng rails, cables & software	SCSI	TBTA1536B	849
8GB Int. w/mntng rails, cables & software	SCSI	TBTA1533B	999

Colorado QIC Tape Backups

Model	Interface	Product Code	Price
350MB Internal Jumbo	Floppy	COJUMBO350	\$149
350MB External Trakker	Parallel	COJT35	299
680MB External Trakker	Parallel	COJT25	359
800MB Internal Travan	Floppy	COHPT1000X	179
1400MB Internal Jumbo	Floppy	COJUMBO1400	319
Tape Backup Cartridges		Product Code	Price
350MB		TBDC2120XL	\$15
680MB		TBMC3000	25
800MB		TBDC45456	29
1400MB		TBDC1400	35

Verbatim

QIC & DAT Tape Media

All Verbatim data cartridges meet or exceed ANSI standards, which means you are assured reliable data recording for even your most critical applications. Tape cartridges are compatible with all quarter inch standard and mini data cartridge tape systems.

Verbatim Cartridges/Discs

QIC Tape Cartridges	Format Use	Product Code	Price
250MB	QIC-80	TBDC2120	\$15
250MB—5 Pack	QIC-80	TBDCVB5PK	59
350MB	QIC-LONG	TBDC2120XL	15
350MB—5 Pack	QIC-LONG	TBDC2120X5	69
4MM (DAT)/8MM Cartridges	Format Use	Product Code	Price
2-4GB	4MM-90 meter	TBM32000	\$12
5-10GB	8MM-112 meter	TBM8MM112	9
Optical/Recordable Discs	Format Use	Product Code	Price
230MB	Magneto Optical	OD3590545	\$29
230MB, 5-pack	Magneto Optical	OD3590545K	129
680MB, 74 minutes	Recordable Disc	OD589185	10

Optical

Optical disks are ideal for all types of storage applications, including high capacity archival storage, or for ready access to larger files that you use more frequently—such as medical, insurance, banking and desktop publishing data.



True 32-Bit Model



NovaBack for Windows® 95

The most powerful all purpose data protection utilities for your PC, workstation or network

A powerful all purpose data protection utility for your PC, workstation or network. NovaBack for Windows® 95 offers a wide range of high-end features including the back for Windows® 95 registry data, Windows NTAS servers, long file names and more. NovaBack offers a true 32-bit mode that supports over 300 different types of tape drives, including all SCSI drives 1/4", 4mm, 8mm, DLT and 1/2" and QIC Travan, 3010, 3020 and QIC-80.

- Easy installation
- Automatic configuration
- Software data compression
- NovaBoot®
- Single floppy disaster recovery utility
- Full network compatibility with Novell Netware®; LANtastic®; Banyan® Vines; and Windows® for Workgroups
- Automated Backups
- QFA (Quick File Access)
- Password protection
- Windows® 95 registry data
- Industry Standard compatibility
- SCSI, QIC-80, QIC-3010, QIC-3020, Parallel port, Notebooks and Libraries
- Dr. Tape™ tape diagnostic utilities

\$35

NovaBack for Windows® 95
216955

All Verbatim products are backed by a lifetime warranty. Insight carries ALL of Verbatim's floppy discs and tape cartridges. Call for pricing!



800-488-0001

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Tape Backup



iomega

Ditto Easy 800

iomega makes backups easy!

No more confusion trying to match tape cartridges with drives. Ditto Easy works with QIC, QIC-wide and Travan cartridges—choose the

\$149.⁹⁵
800MB Internal or External



cartridge that works best for you!

- One-step/no-step software
- Easy to use—easy to install
- Works with DOS, Windows and Windows® 95.

\$149.⁹⁵

Ditto Internal 800MB
TBIO800EA

Iomega QIC Ditto Tape Backups

Model	Int./Ext.	Interface	Product Code	Price
420MB	Internal	Floppy	TBIO420INB	\$99
800MB Easy Travan	Internal	Floppy	TBIO800EA	149.95
800MB Easy Travan	External	Parallel	TBIO800EXT	149.95
3.2GB Travan	Internal	Floppy	TBIO3200TR	319
3.2GB Travan	External	Parallel	TBIO3200TP	429

QIC Tape Cartridges

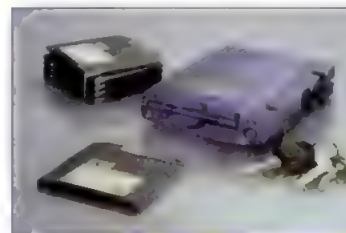
	Product Code	Price
420MB	TBDC5122	\$19
800MB	TBDC45456	29
3.2GB	TBDC3200	35

**Windows 95
COMPATIBLE**

Zip Drive

Affordable personal storage to backup organize and move data—as fast as your hard drive!

- Expand your hard drive without limits with 100MB cartridges
- Portable—fits in your hand and weighs only 1 pound
- Backup your hard drive—fast and easy, 29ms access time, up to 1MB/second transfer rate
- Comes with a 100MB cartridge



\$199.⁹⁵

iomegaZIP
IOZIPSCSI

Available in a
parallel port
interface!

Iomega Removable Drives

Model	Interface	Product Code	Price
ZIP for MAC or PC	SCSI	IOZIPSCSI	\$199.95
ZIP for PC	Parallel	IOZIPPAR	199.95
Bernoulli 230MB w/5 Cartridges	SCSI	BEB1150K	599

Removable Cartridges

	Product Code	Price
100MB ZIP Cartridge for PC	IOZIPCRTPC	\$19.95
100MB ZIP Cartridge for MAC	IOZIPCRTM	19.95
10-pack of ZIP Cartridges for PC	IOZIPC10PC	149
10-pack of ZIP Cartridges for MAC	IOZIPC10M	149
230MB Bernoulli Cartridge	BEB230CART	99



4mm DAT Tape Backups and 90m DAT tapes

The ULTIMATE business storage solution!

3.5" with 5.25" frame, controller card, cable, software, mounting hardware, and tape included.



External kits

External case, controller card, cable, software, SCSI interface and tape included.

\$899

2GB Internal Model 3100
TBXLDATIK

WangDAT High Speed SCSI 4MM DAT Tape Backups

Model	Interface	Product Code	Price
2GB Internal w/contr. & 1 Cart.	SCSI	TBXLDTIK	\$899
4GB Internal with 1 Cartridge	SCSI	TB3200B	949
4GB External with 1 Cartridge	SCSI	TB3200EB	1,049
8GB Internal with 1 Cartridge	SCSI	TB3400B	1,099
8GB External with 1 Cartridge	SCSI	TB3400EB	1,199

4MM DAT Cartridges

	Product Code	Price
90m for up to 2GB	TBM32000	\$12
120m for up to 8GB	TBM120M	25

EXABYTE®

Exabyte 1500 Internal Backup

Fast backups at affordable prices!

The EXB-1500 offers you reliability, high-quality and a low price combined with Exabyte's proven minicartridge technology and the industry standard QIC-3010 MC, and QIC-3020 MC formats. For proven performance and reliability at a great price—backup your data with the EXB-1500!

- Cost-effective tape backup subsystem
- 3.5" form factor
- 500KB, 1MB or 2MB per second transfer rate
- 680/1300MB capacity
- Runs off your floppy controller

\$129

1.3GB QIC Internal EXB 1500
TBEX1500

Uses TBMC3000 cartridges\$25
8mm cartridges up to 14GB TBDC160XL19

Exabyte - High Speed SCSI 8MM Tape Backups

Model	Interface	Product Code	Price
7GB Internal 8205XL	SCSI	TBEX8205	\$1,299
7GB External 8205XLE	SCSI	TBEX8205E	1,599
14GB Internal 8505XL	SCSI	TBEX8505	1,999
14GB External 8505XLE	SCSI	TBEX8505E	2,299
140GB External 10h Library	SCSI	TBEX10H	4,999

Capacity listed is with compression.



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For a fax of product information
or detailed tech documents
call 1-800-755-9654.



Purchase cartridges with capacities equal to or larger than your hard drive's largest partition.



MAGNAVOX

Smart. Very smart.®

Magnavox 17" Monitor

Give your power bill a break! Magnavox monitors offer energy saving, built-in power management!

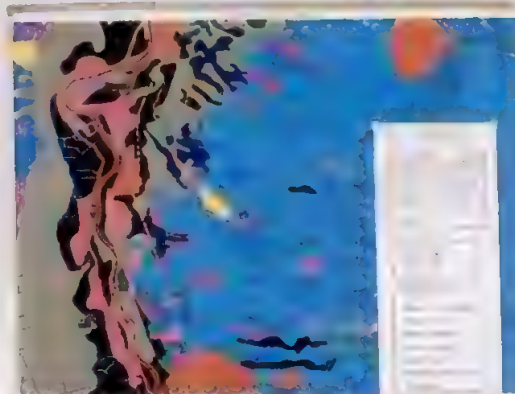
- .28mm dot pitch
- Non-interlaced
- 1280 x 1024 resolution
- Built-in power management system

- Microprocessor-controlled digital geometry adjustment with 13 factory presets and 11 user-definable modes
- OSD (on-screen display) for precise digital control of image parameters
- Tilt and swivel base
- One year limited warranty

\$759

Magnavox 17" Monitor
CMM4018

On Screen Display!



Magnavox Monitors

Model	Size	Resolution	INT/NI	Dot Pitch	Prod. Code	Price
2015	15"	1024 x 768	NI	.28mm	CMMA2015	\$369
4015	15"	1280 x 1024	NI	.28mm	CMMA4015	429
4018	17"	1280 x 1024	NI	.28mm	CMMA4018	759
20CM64	20"	1280 x 1024	NI	.31mm	CMMA20CM64	1,189

Green Energy Monitor!



MAG
INNOVISION



MAG DX15FE 15" Monitor

Green energy monitors provide maximum graphic impression and have little environmental impact

- .28mm dot pitch
- Non-interlaced

- 1280 x 1024 resolution
- Removable 4-way ergonomic tilt and swivel base
- Three year parts, two years on monitor, one year labor warranty

\$369

MAG DX15FE 15" Monitor
CMDX15FE

Mag Monitors

Model	Size	Resolution	INT/NI	Dot Pitch	Prod. Code	Price
DX1495	14"	1024 x 768	NI	.28mm	CMDX1495	\$289
DX15FE	15"	1280 x 1024	NI	.28mm	CMDX15FE	369
DX1595	15"	1280 x 1024	NI	.28mm	CMDX1595	419
DX15T	15"	1280 x 1024	NI	.25mm	CMDX15T	479
DX1795	17"	1280 x 1024	NI	.26mm	CMDX1795	749
DX17T	17"	1280 x 1025	NI	.25mm	CMDX17T	859
MXE15F	15"	1280 x 1024	NI	.28mm	CMMXE15F	479
MXP17F	17"	1600 x 1280	NI	.26mm	CMMXP17F	889
MX21F	21"	1600 x 1280	NI	.28mm	CMMX21F	1,859



Insight

800-488-0001

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Monitors

PRINCETON®

GRAPHIC SYSTEMS

Princeton ULTRA 14" Monitor

The clear winner in performance—and value!

Princeton Graphics Systems has been making monitors since the early 1980's—and that experience has clearly paid off in the Ultra series. The Ultras are compatible with all graphics boards, offer you complete display control and are EPA Energy Star compliant. Each includes a 3 year warranty backed by MAG Innovation.

- .28 dot pitch
- Non-interlaced
- 1024 x 768 resolution
- Vertical size and position controls
- 3 year limited manufacturer's warranty



\$259

ULTRA 14" NI Monitor
CMPGU14NI

Princeton offers a wide variety of monitors suited for business use!

Princeton ULTRA 15" Monitor

Maximum value at a reasonable price!

A line of color monitors that lead the industry in technology and value. With its latest offerings, Princeton Graphics Systems aims to provide users with maximum value by maintaining a tradition of quality and service.

- .28 dot pitch
- Non-interlaced
- 1280 x 1024 resolution
- Digital user controls
- 3 year limited manufacturer's warranty



\$369

ULTRA 15" Monitor
CMPGU15

Princeton Monitors

Model	Size	Resolution	INT/NI	Dot Pitch	Prod. Code	Price
ULTRA14	14"	1024 x 768	NI	.28mm	CMPGU14NI	\$259
ULTRA15	15"	1280 x 1024	NI	.28mm	CMPGU15	369
ULTRA17	17"	1280 x 1024	NI	.28mm	CMPGU17	599

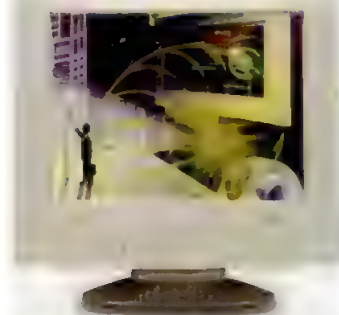
NEC

NEC XV15 Monitor

It's a small price to pay for larger, sharper images!

Now you can maximize your productivity while minimizing your investment. NEC's new line of monitors offers you FullScan technology! Full Plug-and-Play compatibility for Windows 95.

- .28 dot pitch, Dual Dynamic Beam focus
- Multiple frequencies—VGA to non-interlaced
- Flat square technology and high contrast CRT
- 1280 x 1024 resolution (at 60KHz)
- AccuColor® control system
- Removable tilt and swivel base
- Energy Star compliant



\$489

NEC XV15 Monitor
CMNECXV15

NEC Monitors

Model	Size	Resolution	INT/NI	Dot Pitch	Prod. Code	Price
XV14	14"	1024 x 768	NI	.28mm	CMNECXV14	\$339
XV15	15"	1280 x 1024	NI	.28mm	CMNECXV15	489
XV17	17"	1280 x 1024	NI	.28mm	CMNECXV17	839

HITACHI

Hitachi HM-1764 Monitor

New generation of multi-platform monitors for better investment protection

Now you don't have to change monitors every time you change platforms. Hitachi's auto-scanning monitors are designed to work on many different systems. Advanced technology delivers high definition, greater brightness and high contrast for even the most demanding high-resolution applications. Includes user friendly digital controls and maximum adjustability with up to 20 presets and programmable timings. Energy Star compliant for maximum power savings.



\$749

Hitachi 17" Monitor
CMHI1764

Finally!
Affordable
CAD/CAM/CAE
graphics!

Hitachi Monitors

Model	Size	Resolution	INT/NI	Dot Pitch	Prod. Code	Price
HM-1764	17"	1280x768	NI	.28mm	CMHI1764	\$749
HM-4821	21"	1600x1280	NI	.28mm	CMHI4821	1,899

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Insight T-shirt just \$5!

With any purchase over \$50



Interlaced monitors flicker which can cause eyestrain and headaches. Choose non-interlaced monitors for better viewing comfort.

ViewSonic®

See The Difference!™



ViewSonic Monitor

End users, resellers and industry experts alike have proclaimed the advantages of ViewSonic monitors. In independent head to head product comparisons by computer publications, ViewSonic monitors rate consistently as the best overall values. These comparisons included the top brand names in the computer industry.

\$959

ViewSonic 17GA Monitor
CMVSON17GA

ViewSonic Monitors

Model	Size	Resolution	INT/NI	Dot Pitch	Prod. Code	Price
15GA	15"	1280 x 1024	NI	.27mm	CMVSON15GA	\$579
15GS	15"	1280 x 1024	NI	.28mm	CMVSON15GS	499
17GA	17"	1280 x 1024	NI	.27mm	CMVSON17GA	959
17GS	17"	1280 x 1024	NI	.27mm	CMVSON17GS	869
17PS	17"	1600 x 1200	NI	.25mm	CMVSON17PS	1,069
20G	20"	1600 x 1200	NI	.28mm	CMVSON20G	1,489
21PS	21"	1600 x 1200	NI	.25mm	CMVSONIC21	1,929

CTX

CTX 17" Monitor

Not only good for high-end graphics, but everyday word processing and spreadsheet programs as well!

A real value in monitors. Compare the features—CTX images are bright and clear. Non-interlaced with .28 dot pitch and 1280x1024 resolution. You'll get a three year standard warranty for parts and labor. Then compare price.

.28 dot pitch (NI)
1280 x 1024
60KHz
Tilt/Swivel base



\$689

17" CTX Monitor
CM1765GM



CTX Monitors

Model	Size	Resolution	INT/NI	Dot Pitch	Prod. Code	Price
1451C	14"	1024 x 768	NI	.28mm	CMCT1451C	\$269
1565D	15"	1280 x 1024	NI	.28mm	CMCT1565D	399
1765GM	17"	1280 x 1024	NI	.28mm	CM1765GM	689
1785GM	17"	1600 x 1280	NI	.28mm	CMCT1785GM	769
2085	20"	1600 x 1200	NI	.28mm	CMCT2085	1,199

SONY



Trinitron color displays!

\$929

Sony 17SF1 17" Monitor
CM17SF1

Multiscan® 17sf1 Trinitron® Display

The perfect balance between size, functionality and economy!

This 17-inch Trinitron display (16.1" viewable image size) is great for spreadsheets, desktop publishing, design and presentation applications.

- .25mm dot pitch
- 1280 x 1024 @ 60Hz maximum resolution
- Tilt and swivel base
- Energy Star and MPR II compliant

Sony Monitors

Model	Size	Viewable Image Size	Maximum Resolution	Dot Pitch	Prod. Code	Price
1425	14"	13.1"	1024 x 768	.25mm	CMSO1425	\$319
15SF1	15"	14.0"	1280 x 1024	.25mm	CMSE15SF1	519
17SF1	17"	16.1"	1280 x 1024	.25mm	CM17SF1	929
20SE1	20"	19.1"	1600 x 1200	.30mm	CMSE20SE1	1,999

DIAMOND

MULTIMEDIA

Diamond Video Cards

The perfect choice for Mpeg graphics and video performance

- Real time digital video acceleration
- 64-bit graphics performance
- Flicker-free refresh to 120Hz
- Upgradeable to hardware MPEG playback
- Made in the USA



Mpeg upgradeable!

\$339

Stealth 64-bit Video Card
2MB VRAM, 4MB MAX
VCST64VV2R

Diamond Video Cards

BUS	Memory	Graphics	Prod. Code	Price
Stealth Video				
VLB	1MB DRAM, 2MB Max	64-bit	VCSTVV1R	\$169
PCI	1MB DRAM, 2MB Max	64-bit	VCSTVP1R	169
VLB	2MB DRAM, Fixed	64-bit	VCSTVV2R	259
PCI	2MB DRAM, Fixed	64-bit	VCSTVP2R	259
Stealth 64 Video				
VLB	2MB VRAM, 4MB Max	64-bit	VCST64VV2R	\$339
PCI	2MB VRAM, 4MB Max	64-bit	VCST64VP2R	339
VLB	4MB VRAM, Fixed	64-bit	VCST64VV4R	499
PCI	4MB VRAM, Fixed	64-bit	VCST64VP4R	499



800-488-0001

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HYUNDAI DISPLAY PRODUCTS

More than Monitors!

Choosing and purchasing a new color monitor involves more than the screen that sits on your desktop. The company behind the monitor is almost as important as the product itself, and that is the principal behind the new line of DeluxScan high-resolution monitors developed by Hyundai. Hyundai Electronics America is a wholly owned subsidiary of Hyundai Electronics Industries, a leading member of the \$70 billion Hyundai Business Group. Hyundai is dedicated

to customer satisfaction through the continuous pursuit of excellence.

What were once options are now standards for this line of quality monitors all backed by the dependable Hyundai name. Among other benefits, DeluxScan monitors incorporate the following features:

- Digital controls with Programmable Presets
- Flat Screen CRT Technology
- Higher refresh rates
- Higher resolution
- Plug-and-play capability
- Total Green Design

Hyundai Monitors

Model	Size	Resolution	INT/NI	Dot Pitch	Prod. Code	Price
HN4848	14"	1024X768	NI	.28mm	CMHY4848	\$239
HL5848	15"	1024x768	NI	.28mm	CMHY5848	319
HL5864E	15"	1280x1024	NI	.28mm	CMHY5864E	339
HL7864	17"	1280x1024	NI	.28mm	CMHY7864	649
HL7682A	17"	1600x1280	NI	.26mm	CMHY7682A	759
HL2882	21"	1600x1280	NI	.28mm	CMHY2882	1,579



Hyundai DeluxScan 15" Monitor

High performance and reliability at incredibly low prices!

Ideal for general business applications or home-office use. Flat Screen Technology provides resolutions up to 1024 x 768 and minimizes screen distortion for extra-sharp edge-to-edge image quality. Allows you to work longer hours at the computer with reduced eyestrain.



- 15" Flat Screen Technology
- .28mm dot pitch
- Non-glare
- Anti-static
- VESA®/DPMS™ compliant

\$319

Hyundai 15" Monitor
.28mm dot pitch; 1024x768
CMHY5848

Don't forget to upgrade your video card!
64-bit, 2MB PCI Video Cards on
page 39 starting at only \$195!

Hyundai DeluxScan 17" Monitor

Low-cost choice for high graphics quality!

High resolution and a low price make these monitors perfect if you're working with graphical user interfaces such as desktop publishing, mobile computing markets and automated workflow environments. Features include an Invar shadow mask for sharper focus and brightness.



- 17" Flat Screen Technology
- .28mm Invar shadow mask
- Non-glare
- 1280 x 1024 maximum resolution
- VESA®/DPMS™ compliant

\$649

Hyundai 17" Monitor
.28mm dot pitch; 1280x1024
CMHY7864



PARADISE.

Paradise Video Cards

34-bit PCI and Local Bus Video Graphics and Accelerator Cards

The Paradise Bahamas 64 is a 64-bit, DRAM-based accelerated graphics board for Windows that provides high resolutions and true color capabilities for your PC. It is available in both PCI and VESA local bus configurations. Designed for users of Windows, CAD applications, and other graphical user interface (GUI) environments this true-color video graphics accelerator card has features such as a hardware cursor, Bit-BLT (bit block transfers), pattern fills, short stroke vectors and line draws, enhancing the performance of Windows and Windowing programs.

- 2MB of DRAM
- 64 bits
- PCI and VLB



\$199

Paradise Graphics Card
VCXLBAVL2

Paradise Video Cards

Model	Bus	Mem.	Mem.	Max. Mem.	Prod. Code	Price
Bali 32	PCI	DRAM	1MB	2MB	VCXLBALI	\$99
Bali 32	VLB	DRAM	1MB	2MB	VCXLBALIV	99
Bahamas 64	PCI	DRAM	2MB	2MB	VCXLBAPC2	189
Bahamas 64	VLB	DRAM	2MB	2MB	VCXLB AVL2	199
Barbados 64	PCI	VRAM	2MB	2MB	VCXLBAPC2	299



ATI GRAPHICS ACCELERATORS

The ultimate true color performance for the graphics and multimedia professional

ATI's award-winning GRAPHICS PRO TURBO 64-bit graphics accelerator complements today's

486 and Pentium® system by providing PC users with supersonic graphics speed, photo realistic color and sharper image definition.

The GRAPHICS XPRESSION is ATI's award-winning, value packed graphics accelerator. Perfect for Windows and games users who want superior graphics performance at an affordable price. Both come in PCI, ISA and VESA Local bus versions.

\$329

ATI GRAPHICS PRO TURBO
VCATIGPT2

ATI Graphics Accelerators

Model	Bus	Memory	Graphics	Prod. Code	Price
Graphics Xpression	ISA	2MB DRAM	64-Bit	VCATTEXISA	\$195
Graphics Xpression	VLB	2MB DRAM	64-Bit	VCATTEXVLB	195
Graphics Xpression	PCI	2MB DRAM	64-Bit	VCATTEXPCI	195
Graphics Pro Turbo	ISA	2MB VRAM, 4MB MAX	64-Bit	VCATIGPT2	329
Graphics Pro Turbo	VLB	2MB VRAM, 4MB MAX	64-Bit	VCATIGPTV2	329
Graphics Pro Turbo	PCI	2MB VRAM, 4MB MAX	64-Bit	VCATIGPT2	329
Graphics Pro Turbo	ISA	4MB VRAM	64-Bit	VCATIGPT4	469
Graphics Pro Turbo	VLB	4MB VRAM	64-Bit	VCATIGPTV4	469
Graphics Pro Turbo	PCI	4MB VRAM	64-Bit	VCATIGPT4	469

Video Cards



Paradise Pipeline 64-bit video accelerator card

The Paradise Pipeline 64 is an uncompromised, true 64-bit, graphics and **full motion video** accelerator card that provides unparalleled performance in business, education, and entertainment applications.

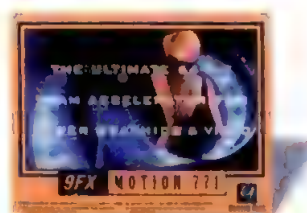
- VESA VL and PCI 2.0 bus versions
- Includes MS DCI driver, MPEG-1 CODEC (MCI) driver
- Comprehensive operating system driver support
- 1MB DRAM upgradeable to 2MB (PCI or VL) or 4MB MB (VL)
- Resolutions up to 1280 by 1024 Non-Interlaced
- Photo-realistic images up to 16.8 millions colors
- Flicker free refresh rates up to 75Hz
- Motion video acceleration at 30 frames per second
- Oasis software to fine-tune your monitor
- 5 year manufacturer's warranty

Mag Monitor/Paradise Pipeline Bundles

Bundle	Product Code	Price
Mag DX17F Monitor Pipeline 64-bit accelerator card	CMDX17PAR2	\$819
Mag DX17F Monitor BALI	CMDX17PAR1	749
Mag 17MXP Monitor Pipeline	CMMX17PAR2	989
Mag MX21F Monitor Pipeline	CMMX21PAR2	1,899



NUMBER NINE
VISUAL TECHNOLOGY



\$299

9FXMOTION 771
64-bit, 2MB Video RAM
VCNU7712P

9FXMOTION 771

For users who want the power of VRAM and the best multimedia performance

- A whole family of award-winning graphics accelerators
- PCI or VLB available (all models)
- Easy installation, no jumpers or switches
- Performance boosters for simple games all the way up to high end desktop publishing applications
- Unlimited technical support
- 5 year manufacturer's warranty

Number Nine Video Cards

Model	Bus	Memory	Graphics	Product Code	Price
9FXVISION 330	PCI	1MB	64 Bit	VCNU3301P	\$139
9FXVISION 330	PCI	2MB	64 Bit	VCNU3302P	199
9FXMOTION 531	PCI	1MB	64 Bit	VCNU5311P	189
9FXMOTION 771	PCI	4MB	64 Bit	VCNU7714P	469
IMAGINE 128	PCI	4MB	64 Bit	VCNU1284P	869
IMAGINE 128-1600	PCI	4MB	64 Bit	VCNU12816P	1,119



Why VRAM? Because with its two paths for simultaneous data it's much faster than conventional DRAM.



800-488-0001

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Scanners

UMAX

The Magic of Color™



PageOffice

- Perfect for quick OCR scanning and image scanning
- Scan documents and print, fax, e-mail, edit, or file
- 300 dpi, 256 shades of gray

\$299

UMAX PageOffice
UMPAGE

PowerLook

- 600x1200 dpi optical, 9600 Max dpi
- Single-pass, 30-bit with over 16.8 million colors
- Includes transparency adapter

\$1,999

UMAX PowerLook
UM2400XK

UMAX Scanner Models

Model	Opt. Res.	Type	Max. Doc.	Prod. Code	Price
Page Office	300 dpi	Roller Mono	8.5" x 14"	UMPAGE	\$299
Vista-S6	600 dpi	Flatbed Color	8.5" x 11.7"	UMVS6K	599
Vista-S8	800 dpi	Flatbed Color	8.5" x 11.7"	UMVS8K	729
UC2360	600 dpi	Flatbed Color	8.5" x 11.7"	UM1260PC	799
Power Look	1200 dpi	Flatbed Color	8.5" x 11.7"	UM2400XK	1,999

caere



OmniForm

OmniForm turns your paper forms into electronic ones—just scan or fax forms into your PC, or use the easy toolset to design your own. Either way, you can fill in and process forms on computer. OmniForm performs calculations and validates and stores entries so you can search, sort, e-mail, import and export information to popular databases.

\$175

OmniForm Windows
216022

OmniPage Pro 6.0 for Windows

New OmniPage® Pro 6.0 produces accurate, editable text from the widest range of documents and can be run directly from your favorite word processor, spreadsheet, or other text-based applications with a single click. The new Quadratic Neural Network achieves greater accuracy with low-resolution documents, while AnyFont™ technology reads virtually any size font, from 6 to 72 points, includes styles. The AutoOCR Toolbar™ easily guides you step-by-step through OCR. OmniPage Pro also includes an integrated 24-bit color image editor, retains page layout and trains OCR to recognize special characters.

\$469

OmniPage Pro 6.0
215853

Insight is a
NASDAQ
traded company



HEWLETT® PACKARD

Great Low
Pricing!

Hewlett-Packard ScanJet 3C Scanner

- 600 dpi optical resolution, 2400 dpi enhanced
- Single pass, 30-bit color internal, 24-bit external
- 8.5" x 13.5" maximum document size

Includes Corel Photo Paint, Calera WordScan OCR, HP ScanJet copy utility and HP DeskScan II

\$949

HP ScanJet 3C
HPSJ3C

Hewlett-Packard Scanner Models

Accessories	Prod. Code	Price
ADF Sheet feeder for 3C	HPSJ3IADF	\$469
Transparency Adapter for 3C	HPSJ3IIT	649

Canon

IX-4015 Scanner

- Flatbed color scanner
- 24-bit color, 1 pass
- 400 x 1200dpi optical resolution
- Image editing software—OFOTO 2.0
- 8.5" x 11.7" Max. document size
- 16.7 million colors

Optional 20-page document feeder available

\$699

Canon IX-4015 Color Scanner
CNIX4015W

MICROTEK



Lightweight,
compact and
portable instant
scanner
under \$200!



ScanMaker IISF

- Flatbed color scanner
- 24-bit color, 1 pass
- 300 x 600dpi optical resolution
- Includes image editing software

\$489

Microtek ScanMaker IISF
SCMTSPII

PageWiz

Converts documents and photos into digital files that you can edit, store, fax, e-mail or print—if it's on paper, it can be in your PC fast!

\$199

Microtek PageWiz
SCMTWIZ

MICROTEK Models & Accessories

Model	Opt. Res.	Type	Max. Doc.	Prod. Code	Price
ScanMaker IISF	300 dpi	Flatbed Color	8.5" x 11.7"	SCMTSPII	\$489
ScanMaker IISHR	600 dpi	Flatbed Color	8.5" x 14"	SCMTHRIIR	579
ScanMaker IISFX	300 dpi	Flatbed Color	8.5" x 11.7"	SCMTIISFX	689
PageWiz	300 dpi	Roller Mono	8.5" x 14"	SCMTWIZ	199

Accessories	Prod. Code	Price
Auto Document Feeder (All Models)	SCMTDOCFD	\$379
Transparency Adapter (All Models)	SCMTTRANSAD	509

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EPSON®

**2 Year
Warranty!**

Epson Action Laser 1400

The Best value in true 600 dpi laser printing

Now you can have the sharpness and detail of 600dpi laser printing for less than you'd expect. Unlike many laser printers in its price range, the ActionLaser 1400 offers true 600x600 dpi resolution with Epson's edge-smoothing technology and microfine toner, giving you exceptional print quality.

Convenient features include a built-in 100-sheet paper tray that feeds letter or legal size paper and envelopes. A Windows™ 3.1 driver and Printer Control Panel software makes setup and control a snap. And a 4,000 page imaging cartridge is included. It all adds up to the best value in laser printing.

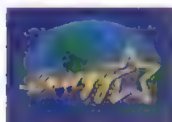


- 4 pages per minute
- True 600 x 600 dpi resolution
- Rich, sharp output of text and graphics
- 2MB standard memory
- Windows compatible
- 2 year limited warranty

\$499

Epson Action Laser 1400
EPSC148001

Printers



Epson Printer Models

Action Laser	PPM	DPI	Memory	Fonts	Prod. Code	Price
AL 1400	4	600	2MB	45	EPSC148001	\$499
Ink Jet	PPM	DPI	Memory	Fonts	Prod. Code	Price
Stylus Color II	4	720	56K	9	EPSSCLRII	\$449
Stylus Color Pro	3	720	64K	9	EPSSPRO	799
Dot Matrix	CPS	DPI	Carriage	Pins	Prod. Code	Price
LQ-300	240	360	Narrow	24	EPSLQ300	\$189
LQ-570+	225	360	Narrow	24	EPSLQ57+	269
LQ-1070+	225	360	Wide	24	EPSL107+	409
DFX-5000+	560	240	Wide	9	EPSPDFX-5+	1,559
DFX-8000	1066	240	Wide	9	EPSPDFX-8	2,575

Epson Supplies & Accessories

Accessories	Product Code	Price
Toner Cartridge for Action Laser 1100/1400	EPSS051023	\$139
Color Ink Cartridge for Stylus Color II	EPSS020049	39
Black Ink Cartridge for Stylus Color II	EPSS020047	25
Color Ink Cartridge for Stylus Color/Pro	EPSS020036	35
Black Ink Cartridge for Stylus Color/Pro	EPSS020034	19
Stylus Color special coated paper	EPSS041029	22

*Call your sales representative for more details on the appropriate accessory items for your printer.

OKIDATA

OL600E Printer

A Compact Personal Printer Now with 600dpi Class Output

A solid combination of laser-perfect high resolution, fast printing speed and superior reliability at an affordable price!

600dpi class output for superior looking text and graphics for business or home office use

Fast, 6 pages per minute printing speed via 25MHz RISC microprocessor

Standard 1MB of memory with Enhanced Memory Management (2MB effective memory) for reliable



NEW!



- printing of virtually any page. Memory expandable to 18MB.
- Fully DOS® and Windows® and Plug-and-Play compatible
 - Expandable paper handling options—high capacity 2nd Tray Mechanism (250 sheets), Multi-purpose Feeder (100 sheet/50 envelopes)
 - 5 year printhead limited warranty and full year limited warranty on parts and labor

\$399

Okidata OL600E
OKI600E

Okidata Printer Models

LED	PPM	DPI	Memory	Fonts	Prod. Code	Price
OL400E	4	300	512K	44	OKI400E	\$299*
OL600E	6	600	1MB	44	OKI600E	399
OL410E	4	600	2MB	14	OKI410E	519
OL610E	6	600	2MB	45	OKI610E	509
OL810E	8	600	2MB	45	OKI810E	779
OL610E/PS	6	600	2MB	82	OKI610EPS	719
OL1200	12	600	2MB	50	OKI1200	1,099
Dot Matrix	CPS	DPI	Pins	Carriage	Prod. Code	Price
ML 184	300	240	9	Narrow	OKIML184	\$239
ML 380	240	360	24	Narrow	OKI380	239
ML 320	300	288	9	Narrow	OKI320	329
ML 590	360	360	24	Narrow	OKI590	469
ML 591+	360	360	24	Wide	OKI591+	639
ML 395	486	360	24	Wide	OKIML395	1,059

Ink Jet	PPM	DPI	Eng.Star Warranty	Prod. Code	Price
Okijet 2010	3	600	Yes	2 year OKI2010	\$369

*After \$50 manufacturer's mail-in rebate (expires October 31, 1995).

Okidata Supplies & Accessories

Accessories	Product Code	Price
Oki Toner Cartridge for OL400E, OL410E, OL410EPS	OK400TONER	\$20
Oki Black Ribbon Cartridge for Microline 395	OKI03601	21
Oki Black Ink Cartridge for Okijet 2010	OKI09301	36
Oki Toner Cartridge for OL1200	OKI09201	45
Oki Color Option Kit for Microline 590, 591	OKI590CK	59
Oki Image Drum Cartridge for OL400E, OK410E, OL810E	OKI16801	149



800-488-0001

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Printers

Hewlett-Packard OfficeJet Printer Fax Copier



NEW!

Three products in one

- Integrated printer, fax, and copier
- Plain-paper faxes
- 24-page fax memory
- High-quality HP DeskJet compatible printer
- 3 pages per minute
- 1 year manufacturer's warranty

\$609

HP OfficeJet
HPC2890A

Hewlett-Packard LaserJet 5L Printer

Enjoy outstanding laser quality at a very affordable price

- Produces high-quality documents on a variety of papers
- Crisp blacks with 600x600 dpi for impressive-looking documents
- More creative printing in Windows® with HP FontSmart—up to 110 TrueType fonts
- 1 year warranty

\$519

HP LaserJet 5L Printer
HPLJ5L

Hewlett-Packard Multifunction Systems

Model	Prod. Code	Price
HP OfficeJet Personal Printer*/Fax**/Copier	HPC2890A	\$609
HP OfficeJet LX Personal Printer*/Fax**/Copier	HPC2891A	729

* 3ppm/300x600dpi
** Plain paper fax

TEXAS INSTRUMENTS



\$839

MicroLaser™ 600
TEX1030

MicroLaser™ 600

Redefining what you expect from office printers

Waiting for 600 dpi printing but couldn't afford it? Now 600 dpi PostScript printing is within reach of every business.

- 600 dpi resolution
- 5 pages per minute (with RISC processor)
- 2MB of memory with Adobe Memory Booster™
- Adobe PostScript Level 2, 23 fonts
- Intelligent port/language switching
- Mac/Windows/DOS compatible

Texas Instruments Printer Models

Laser Models	PPM	Mem.	Fonts	DPI	Prod. Code	Price
MicroLaser 600	5	2MB*	23PS	600	TEX1030	\$839
MicroLaser Pro Ps23	8	3MB*	23PS	600	TEX1024	1,169
MicroLaser Pro E	12	3MB*	23PS	600	TEX1029	1,349
MicroLaser Power Pro	12	6MB	67PS	600	TEX1028	1,599

* Adobe Memory Booster

Texas Instruments Supplies & Accessories

Accessories	Prod. Code	Price
TI Toner Cartridge for MicroLaser 600	TEX3577	\$49
TI Imaging Cartridge/Toner for MicroLaser Pro 600	TEX3482	174
TI Imaging Cartridge for MicroLaser Pro E, Power Pro	TEX3582	199



**HEWLETT®
PACKARD**

Hewlett-Packard Printer Models

DeskJet	PPM	Mem	Fonts	DPI	Prod. Code	Price
HP DeskJet 340 Printer	3	64K	20	300x600	HPDJ340	\$299
HP DeskJet 600 Printer	4	512K	22	600x600	HPDJ600	299
HP DeskJet 660C Printer	4	512K	14	600x600	HPDJ660C	399
HP DeskJet 850C Printer	6	1MB	40	600x600	HPDJ850C	559
HP DeskJet 1600C Printer	9	4MB	45	600x600	HPDJ1600C	1,379
HP DeskJet 1600CM Printer	9	6MB	45	600x600	HPDJ1600CM	1,989

LaserJet	PPM	Mem	Fonts	DPI	Prod. Code	Price
HP LaserJet 5L Printer	4	1MB	26	600	HPLJ5L	\$519
HP LaserJet 5P Printer	6	2MB	54	600	HPLJ5P	879
HP LaserJet 5MP Printer	6	3MB	35PS	600	HPLJ5MP	1,039

Hewlett-Packard Supplies & Accessories

Accessories	Prod. Code	Price
Color Option Kit for DeskJet 320, 540	HPDJ310CLR	\$39
Color Ink Cartridge for DeskJet 320, 540, 550C, 560C	HPCDJ51C	29
Color Ink Cartridge for DeskJet 660C	HP51649A	29
High Capacity Black Ink Cartridge for DeskJet 660C	HP51629A	29
Black Ink Cartridge for DeskJet 1600C, 1600CM	HP51645A	35
Cyan Ink Cartridge for DeskJet 1200C, 1600C, 1600CM	HPDJCYAN	30
Magenta Ink Cartridge for DeskJet 1200C, 1600C, 1600CM	HPDJMC	30
Yellow Ink Cartridge for DeskJet 1200C, 1600C, 1600CM	HPDJYC	30
Toner Cartridge for LaserJet 5P, 5MP	HPC3903A	89

Canon

Canon Bubble Jet BJC-610 Color Printer

Includes graphics software bundle!

- What can you do with a Canon Printer?
- Make greeting cards, t-shirts, stickers and more with Canon Creative CD-ROM including Hallmark connections™ Everyday Greetings™ and Crayola® Art
- Near photographic color output at

720/720 dpi
on plain
paper

- Free 2-year warranty and 15 hour toll-free support
- No-waste ink cartridge system
- Print color on plain paper, transparencies, even fabric

\$549

Canon BJC-610
CNBJC610

Canon Printer Models

Bubble Jet	CPS	Mem	Fonts	DPI	Prod. Code	Price
BJ-30 Portable	346	35K	20	720	CNBJ30	\$269
BJC-210	248	N/A	300*	360	CNBJC210	289
BJC-70 Color Port.	346	35K	20	720	CNBJC70	359
BJC-4100	0.8	N/A	300*	720	CNBJC4100	379
BJC-610	300	64K	300*	720	CNBJC610	549

Laser	PPM	Mem	Fonts	DPI	Prod. Code	Price
LBP-460	4	N/A	300*	600	CNLBP460	\$399

*True type fonts are included on the Canon Creative CD-ROM

Canon Supplies & Accessories

Accessories	Product Code	Price
BJ-30/BJC-70 Black Ink Cartridge	CNBJC10	\$45
BJC-70 Color Ink Cartridge	CNBJC11	49
Black Ink Cartridge for BJC-4000 series	CNBJC20	31
Color Ink Cartridge for BJC-4000 series	CNBJC21	49
Black Ink Cartridge (High Capacity) for BJC-600 series	CNBJC201HC	75
Specialty Paper Starter Kit for BJC-600/BJC-4000 series	CNSK101	15
Bubble Jet Paper (letter), Water Resistant	CNLC301	22

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**For immediate product information
just e-mail Insight at
info@insight.com**

Insight

REVEAL™

**Internal Q100
CD-ROM Drive
Quad Speed
Blazing
600KB/second
transfer rate for
smoother video
and a faster
game play!**

Enjoy the lively animation, action video, high-definition graphics and rich stereo soundtracks of today's hottest multimedia applications with the QUAD-speed drive from Reveal™. In addition, you get one of today's hottest titles on CD-ROM, the New Grolier Multimedia Encyclopedia. As for connectivity, the Reveal™ QUAD-speed is IDE/ATAPI compatible. That means that you can hook it up to any IDE connector already installed in your computer, or use the high speed IDE/ATAPI card included with the drive.



- Quad Speed Drive with controller
- 600KB/second transfer
- 250ms access
- IDE/ATAPI adapter
- New Grolier MM Encyclopedia

\$179

Q100
RVCDQ100



**Wave Table Card
Shatter the
limitations of
FM synthesis"**

The SC500 WAVE Sound FX™ plays actual pre-recorded sounds of musical instruments (from piano to bongo drums) and sound effects. A special chipset contains 226 sounds, and up to 4 can be played at once.

The audio tracks on games, multimedia presentations and other audio applications will sound like they're coming from a home stereo system. The sound quality will blow you away!

- Versatile CD-ROM interface with IDE, Panasonic®, Sony® and Mitsumi® CD-ROM support
- Compatible with popular sound standards including: SoundBlaster Pro™, Roland's MT-32 and General MIDI, Microsoft's® Windows Sound System™
- Large array of audio programs

\$139

Wave Table Card
MMRVSC500

Multimedia Kits



**46 CD titles
including
audio-editing
programs**

K4X40 Reveal Internal Multimedia Kit with Wave Table Sound Card

**4X CD-ROM, wavetable
card, speakers, plus 46
CD titles**

For the ultimate multimedia experience, you need Reveal's K4X40 professional kit loaded with top-of-the-line components. You get a high-performance quad-speed internal CD-ROM, 80-watt stereo speaker system, 46 popular CDs, headphones and microphone, plus the acclaimed SoundFX Wave 16-bit sound card. This amazing wavetable card produces full, rich, digital sound that will astonish you. Unlike other cards that only

approximate sounds on CDs, the SoundFX Wave delivers the real thing. Includes 226 pre-recorded sounds and lets you record and playback in stereo up to 32 voices. Compatible with most standards including SoundBlaster Pro, MS Sound System, General MIDI and many more. If you're serious about your multimedia—the Reveal K4X40 kit sounds like the ideal choice.

- Quad-speed internal CD-ROM IDE/ATAPI (600KB/250ms)
- 16-bit wavetable sound card
- 80-watt shielded stereo speaker system
- Stereo headphones
- Microphone
- All cables, mounting hardware and installation video
- Joystick included

\$479

K4X40
MMRVMK4X40

**FREE
Installation
Video!**

TV Tuner for PC Card Watch TV on your computer's monitor!

Watch the financial news channel while you fill out a spreadsheet. You can capture frames from TV or video action, and place the images into your documents.

You can even use the card as a color scanner. Simply focus your video camera on photographs, slides, artwork, people or virtually anything, then capture the image with the TV500 card.

- 125 channel support (NTSC format)
- Closed caption support with save to file (ASCII text format)
- 12 channel picture preview
- Resolution support to 1024x768 (with video card support)
- Resizable live picture

- On screen TV remote with picture preview
- Auto channel frequency scan and detect
- Freeze frame support & single frame capture
- Video contrast, brightness, tint, sharpness, and color control
- Video selectable of TV or VCR/Camcorder
- Audio choice of tuner or RCA inputs
- User definable zoom area

\$199

TV Board
RVTV500



Add a sound card and speakers to your CD-ROM and you've built yourself a full scale multi-media system!



800-488-0001



Multimedia/Speakers

CREATIVE
CREATIVE LABS, INC.



Sound Blaster Performance™ 4x

The ultimate in multimedia. Achieve real instrument sounds and quad-speed CD-ROM technology with Sound Blaster Performance™ 4x. This powerful multimedia kit includes Sound Blaster™ 32, the next-generation Sound Blaster with wave-table synthesis, a quad-speed CD-ROM, powered stereo speakers, and 24 titles such as Descent™, Destination Saturn, Shadowcaster™, and KidWorks™ 2.

Quad-Speed IDE drive

- 600K transfer rate
- 230ms access time
- 256K buffer

Wave Table 32 card

- Speakers
- 24 titles

\$399

Performance™ 4x
MMCLDPERF

Creative Labs Multimedia Kits

Description	Product Code	Price
Sound Blaster MIDI Kit	MMCLMIDIKC	\$59
16 IDE	MMCLSB16VI	99
Video Blaster RT-300	MMCLVBRT	359
Discovery Quad Kit	MMCLDISC4X	379
Game Blaster Multimedia Kit	MMCLGB	419
Sound Blaster Home 4X	MMCLDHOME	429
Performance Wave kit	MMCLDPERF	399
SB 32 IDE	MMCLSB32VI	169
Schoolhouse Quad kit	MMCLDSH4	349



First 8-speed drive!

DIAMOND

Multimedia Kit 8000 8X CD-ROM Drive- Yamaha Speakers- 3D Wavetable Sound

The ultimate multimedia kit with the fastest CD-ROM drive in the world provides everything that a high performance user desires. The Diamond 8000 kit includes the first 8X CD-ROM drive in the market today, delivering data at a blazing speed of 1,200KB/second; high-quality 32 voices, 16-bit wavetable Plug & Play sound card using actual instruments to create incredible audio with 3D sound; high-fidelity Yamaha powered speakers; and today's top selling entertain-

ment titles along with the 1996 edition of Compton's Interactive Encyclopedia™. You won't believe the performance packed into this state of the art multimedia kit.

- Super fast 8X CD-ROM drive
- 16-bit Wavetable Plug & Play Sound Card with 3D sound
- High quality Yamaha stereo speakers
- 5 best selling software titles
- Works with All Sound Blaster compatible games
- Quick and easy installation tool
- Unlimited technical support

\$579

Diamond MM Kit 8000
MMD8000

Diamond

Description	Product Code	Price
4400 Quad IDE MM Kit	MMD4400	\$299
8X Wavetable MM Kit	MMD8000	579
16-bit Wavetable Card	MMDXWAVE	99

NEC

The NEC 6-Speed!



Hi-Val Six Speed Internal SCSI Includes Groliers 1995 MM Encyclopedia

Experience high performance and reliability with NEC's top-of-the-line 6X CD-ROM Drive. This drive features a 145ms access time, 900 K/second data transfer rate, 256K buffer memory for smooth data transfer. Comes bundled with Groliers 95 Encyclopedia v.7.04.

- SCSI-2 Interface
- Six speed high performance
- 145ms access time
- 900K/second transfer rate
- Automatic load/unloading with caddy
- Standard 5 1/2 inch form factor
- MPC-2 compatible
- 1 year warranty

\$399

Hi-Val Six speed
ODNC512

HITACHI

Hitachi Internal Quad-Speed IDE upgrade kit Upgrade your CD-ROM to Quad-Speed for under \$150

Get the faster, smoother performance of 4x you need for today's hottest CD titles. Easy to instal kit includes everything you need to go from 2x to 4x in just minutes!

- Enhanced IDE interface
- Fast 240ms access time
- 600K/second data transfer rate
- Photo CD multisession and MPC-2 compliant
- Power tray loading

\$149

Hi-Val Quad-speed
ODHTQUAD



Hi-Val Edutainment Top 5 CD titles included

- Hitachi 7730 4X IDE Drive, Man/SW driver/audio & data cables
- 16-bit sound card, Labtec 180 speakers, DOOM II

- Descent "Destination Saturn," Cyberia "Mission Norway"
- StarWars "Rebel Assault," Special Edition, Groliers Encyclopedia 1995
- 30 shareware titles

\$299

Hi-Val Edutainment
MMHVEDUT1

44

Call anytime, 24 hours a day,
365 days a year.





miroVIDEO DC1 plus Digital Video Editing System

• Captures 320x240 M-JPEG
compressed TrueColor video at 30
fps to hard drive
• Display card compatible with any
graphics card at any mode (up to
11600x1280, 24-bit)
• Includes video editing and 3D
animation software

- Output to video (TV or VCR) at 640x480 at 30 fps in Super VHS quality
- Includes miro drivers and bundled software:
Adobe Photoshop 4.0 LE
Asymetrix 3D F/X

\$479

Miro DC1 Plus
MMVDC1PLS

Multimedia/Speakers



AverMedia

AverKey 3

Turn your TV into a
powerful presentation
tool!

The AverKey 3 converts your computer screens into a video signal that can be displayed on any TV monitor. The ideal solution for new business pitches, sales meetings, or classroom presentations. Includes converter, remote control, power supply and all cables.

- Advanced flicker-free technology for riveting presentations
- 800 x 600 resolution
- Underscan/Overscan lets you display whole screen images on TV

- Zoom and Pan functions make your points with impact
- Screen Freeze for clear viewing
- Remote control operation lets you present from anywhere in the room
- Simultaneous display on both computer and TV monitors
- Plug and play—no software driver to install
- Macromedia Action! software included

\$299

AverKey 3
AVERKEY3

AverMedia

Description	Product Code	Price
Averkey PC 640x480 TV converter for PC	AVERKEYPC	\$99
Averkey PCM PC/MAC converter for PC or Mac	AVERKEYPCM	199
Averkey 3U 800x600 converter for PC or Mac	AVERKEY3U	399
Averkey 3 for PC converter for PC	AVERKEY3	299

Wave Table Sound and TV Cards!



Wave Table Sound and TV Cards

Turtle Beach	Product Code	Price
Tropez—16-bit wave, upg. to 12MB RAM	MMBTROPEZ	\$219
MonteCarlo—16 bit sound, wavetable synthesizer software	MMTBMONTE	99
Creative Labs	Product Code	Price
SoundBlaster 32 IDE Wave w/1MB ROM— 16-bit wave, 20 note, 4 operator syn.	MMCLSB32	\$169
WaveBlaster 2—Daughter board to add wave to any SB board	MMCLWVAD	149
Crystal Lake	Product Code	Price
Crystal Clear—16-bit sound, 32 note sound board	MMCRL40014	\$199
Ensoniq	Product Code	Price
SoundScape—16-bit wavetable sound card	MMEQSCAPE	\$159
Reveal	Product Code	Price
SC500—16-bit wavetable card	MMRVSC500	\$139
Diamond	Product Code	Price
Diamond—16-bit wavetable card	MMDCWAVE	\$99
Altech	Product Code	Price
Wave watcher TV Tuner w/video capture	AI04503TV	\$349

Speakers

SONY
REVEAL



Speakers

Altec	Product Code	Price
ACS50-4.5 watt per channel	ACS50	\$65
ACS300-1-18 watt with subwoofer	ACS3001	229
Labtec	Product Code	Price
MCS-600 4 watt speakers	LTCSC600	\$29
CS-900 2-way, 7 watt amplified speakers	LTCSC900	69
Sony	Product Code	Price
PC30-3 watt, magnetically shielded	SESRSPC30	\$65
B100-7 watt multimedia speaker console	SECSSB100	99
Reveal	Product Code	Price
RS300-8 watt amplified speakers	RVRS300	\$35
RS380-80 watt with ducted bass ports	RVRS380	79
Jazz	Product Code	Price
Z306-8 watt power speakers	MMJZ306	\$29
Yamaha	Product Code	Price
YST-M10-10 watt with active servo	MMYSTM10	\$75



800-488-0001

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Modems

BOCA
RESEARCH INC.



28.8 V.34

28.8 V.34 Modem

There are no speeding tickets on-line—so floor it with Boca

Boca Research introduces the new V.34 28.8 bps modem! It's the highest speed modem available for data transmission over standard phone lines. You'll cruise at a maximum throughput of 115.2K bps—which means shorter connect times, faster data rates and faster delivery of large data files. With data transmission speeds 100% faster than V.32 bit modems, you'll save money on phone bills and

increase your productivity.

- 28.8 bps data communications
- 14.4 bps send/receive group
- Sends and receives faxes in background
- Includes fax and data communications software for Windows
- Free on-line services from CompuServe, Genie, and America Online

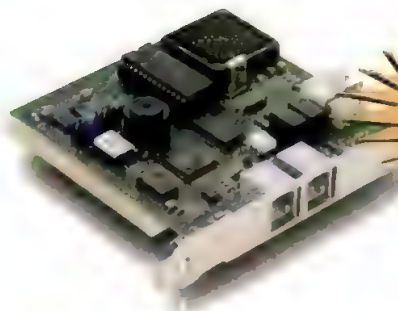
\$189

28.8 Modem
MBBV.34ER

Boca

Description	Type	Data/Fax Rate	Product Code	Price
14.4 Modem	INT	14.4/14.4	MBBR14.4I	\$79
Sound Expression	INT	14.4/14.4	MBBRSE14I	169
28.8 Modem	INT	28.8/14.4	MBBRV.34IR	169
28.8 Modem	EXT	28.8/14.4	MBBRV.34ER	189
Voice View 14.4	INT	14.4/14.4 DSVD	MBBR144VVI	99

AVD/Alternative Voice/Data



**Comes with
FREE
WWW browser**

Internal Half-card

- Fax/Data/Voice software
- VoiceView® TalkShop™ software
- High-speed 14.4Kbps
- Data/Fax/Voice Modem
- 14.4 Kbps send/receive group 3 fax
- Microphone and speaker jack

VoiceView TalkShop

VoiceView TalkShop is a Windows application for VoiceView-certified modem which allows you to talk and exchange computer data during a normal phone call. It alternates between voice and data once the data goes through, you're automatically switched back to your voice conversation.

It contains:

- Internal 14.4Kbps Multimedia Voice Modem with VoiceView and
- It lets users:
- Shop by phone, and obtain product information on screen
 - Exchange business cards electronically
 - Send and receive files, then discuss changes to documents
 - Play interactive games, and keep a running conversation with an opponent

\$99

VoiceView TalkShop
MODBT144VVI



MOTOROLA

BitSURFER and ISDN

All digital, high speed with simultaneous voice and data for your home or office

Motorola's BitSURFER is a terminal adapter for the high-speed, digital ISDN telephone service. Ideal for the small office, branch office, or work-at-home user, BitSURFER is an all-in-one combination of hardware and software ready to connect your PC, telephone and fax machine to ISDN.

- Over twice the speed of the fastest modem

- Simultaneous voice and data on a single ISDN line
- Everything you need for ISDN—built-in NT1 and ISDN line ordering codes
- Works with AT compatible software
- Easy to use and install
- Unparalleled Motorola quality and reliability

\$279

BitSURFER
MBMOTISDN

Motorola

Description	Type	Data/Fax Rate	Product Code	Price
Lifestyle 28.8	EXT	28.8/14.4	MBMOTLV34E	\$219
Lifestyle 28.8 Cell	PCMCIA	28.8/14.4	MBMOTLV34P	289
Power 28.8	EXT	28.8/14.4	MBMOTPV34E	259
Marquis 28.8 Eth	PCMCIA	28.8/14.4	MBMOTM28LP	499
BitSURFER	EXT	128 Kbps	MBMOTISDN	379
BitSURFER	ISA	115.2 Kbps	MBMOTISDN	279
BitSURFER Pro	EXT	128 Kbps	MBMOTIPRO	389

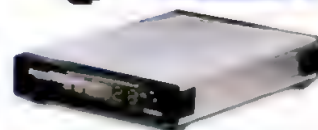
Free introductory offers from American OnLine, CompuServe, Prodigy
BitSURFER comes with free Motorola Communication toolkit

Insight is a
NASDAQ
traded company



Supra Corporation®

Plug and Play



SupraFAXModem 28.8 for PC

SupraFAXModem™ 28.8 offers 28,800 bps data speeds, 14,400 bps fax plus an easy-to-read numeric panel. Includes top-quality software, cables and manuals.

\$159

FaxModem 28.8/14.4 Internal
MBSUPEXPNP

Supra

Description	Type	Data/Fax Rate	Product Code	Price
144iPnP	INT	14.4/14.4	MBSUP14PI	\$79
SupraEXPRESS 28.8 PNP	INT	28.8/14.4	MBSUPEXPNP	159
SupraEXPRESS 28.8 PNP	EXT	28.8/14.4	MBSUPEX28E	179
Supra Simple Internet	INT	115.2Kbps	MBSUPSSII	179
Supra Simple Internet	EXT	115.2Kbps	MBSUPSSIE	189

28.8 Plug
and Play



SupraSimple Internet

Supra Corporation is pleased to announce its "all-in-one" Internet solution, Supra Simple Internet. This complete solution includes a 28.8 bps Supra faxmodem, easy connection with the nation's largest service provider, and point-and-click software for accessing e-mail, the Web, Gopher and more. Supra will ship three versions of the Supra Simple Internet Product: The Supra Simple Internet PC (with internal modem), the Supra Simple Internet PC (with external modem), and the Supra Simple Internet Mac (with external modem).

\$179

Simple Internet Internal
MBSUPSSII



Sportster 28.8, V.34 High Speed Modems

The ITU-T 28.8 bps standard for data transmission at 28.8 bps.

Sportster 28.8 V.34 Data/Fax®

Supports true ITU-TV.34 and V.FC™ at 28.8 bps, ITU-TV.32 bis at 14.4 bps, backward compatible with slower speeds down to 300 bps

Hardware-based V.42/MNP 2-4 error control and V.42 bis/MNP 5 data compression for error-free throughput up to 115.2 bps with any communication software.

Sportster VI 28.8 V.34

True V.34™ data transmission at 28.8 bps with both V.34 and V.FC™ modems.

Group III Class 1 and Class 2.0 fax at 14.4 and 9.6 bps

V.42/MNP 2-4 error-free control and V.42 bis/MNP 5 data compression for throughput up to 115.2 bps (57.6 bps for Sportster VI 14.4)

U.S. Robotics

Description	Type	Data/Fax Rate	Product Code	Price
Sportster SI 14.4	INT	14.4/14.4	MBUSRSI14I	\$49
Sportster SI 14.4	EXT	14.4/14.4	MBUSRSI14E	59
Sportster 14.4	INT	14.4/14.4	MBUSR0276	99
Sportster 14.4	EXT	14.4/14.4	MBSPORT14F	119
Sportster 28.8	INT	28.8/14.4	MBUSRSP34I	199
Sportster 28.8	EXT	28.8/14.4	MBUSRSP34E	219
Sportster VI 14.4	INT	14.4/14.4	MBUSRV114I	119
Sportster VI 14.4	EXT	14.4/14.4	MBUSRV114E	139
Sportster VI 28.8	INT	28.8/14.4	MBUSRV128I	219
Sportster VI 28.8	EXT	28.8/14.4	MBUSRV134E	239

Sportster® Vi Faxmodem with Personal Voice Mail

New Sportster Vi with Personal Voice Mail puts all the convenience of an answering machine, a fax machine and a reliable U.S. Robotics modem in one compact unit—and it's easy to use, right from your home or office PC. In addition, Sportster Vi lets you talk and send data in one call, over an ordinary phone line.

- Sportster Vi replaces an answering machine
- Sportster Vi is better than a fax machine
- Talk and send data in the same call
- Sportster Vi is compatible with other modems

28.8 V.34
Voice View

Windows 95
COMPATIBLE

- Provides business-quality voice mail with multiple mailboxes
- Retrieves fax and voice messages from remote locations
- Compatible with all ITU-T standard modems from 28.8 to 300 bps
- Internal versions include built-in 16550 UART for improved performance
- Supports the industry-standard AT command set
- 5 year limited manufacturer's warranty including free parts and service, factory repair or replacement

\$239

U.S. Robotics 28.8, V.34
MBUSRV134E

Best
Value!



MAXTECH

Maxtech 28.8KBps Fax Modem

28.8, V.34 Plug-n-Play with voice and speakerphone for only \$189

Finally, an affordable 28.8VFC modem you can count on to deliver



speed and value. Includes DOS and Windows COMit software, plus WinFaxLite and DOS-Fax Lite.

\$189

Internal 28.8V.34
PNP w/voice speakerphone
MBMX28VSP

Maxtech

Description	Type	Data/Fax Rate	Prod. Code	Price
Internal 14.4	INT	14.4/14.4	MBMX14I	\$45
Internal 14.4 w/voice	INT	14.4/14.4	MBMX14IV	65
Internal 14.4 w/voice/speakerphone	INT	14.4/14.4	MBMX14IVS	79
Internal 14.4 PNP w/voice/speakerphone	INT	14.4/14.4	MBMX14IVSP	95
External 14.4 w/voice	EXT	14.4/14.4	MBMX14EV	105
Internal 28.8 V.34	INT	28.8/14.4	MBMX28I	155
Internal 28.8 V.34 PNP w/voice/speakerphone	INT	28.8/14.4	MBMX28IVSP	189
PCMCIA 14.4	PC Card	14.4/14.4	MBMX14PC	139
PCMCIA 28.8	PC Card	28.8/14.4	MBMX28PC	289



Wavetable
Sound and 28.8, V.34
All in one!

miroCONNECT 34 wave

All-in-one communications board and software. High-speed data transfer with V.34 modem (28,800 bps). High-quality fax (14,400 bps). Intuitive functionality for ease of use. Multi-tasking capabilities with automatic recognition system for phone, fax, and data messages. DSP technology for maximum processing power. 32-voice wavetable sound for



\$299

miroCONNECT 34 Wave
MBMP34WAVE

business and games. Includes Internet access software and Intel ProShare trial version. Jumperless configuration, fast CD software installation.



800-488-0001



Internet



Internet In A Box

The complete Internet solution—now even better

Now getting on and surfing the Net is faster and more fun than ever before.

The new version of this award-winning program includes inexpensive and reliable internet access, secure Web browser, electronic Spry e-mail spellchecker, one-button image decoding and over 50 other enhancements!

Mosaic In A Box

Mosaic in a Box for Windows 95

Mosaic In A Box has added the power of Windows 95 to the world's best-selling Internet browser for the fastest possible Internet connection! Now you can link to thousands of services and databases with the click of a button; view text, multimedia graphics and video almost instantly, and connect to resources faster than ever before!

\$39

Internet In A Box Upgrade 3.5" 214715

\$95

Internet In A Box 3.5" 214716



\$19

Mosaic In A Box Win '95 215717



GLOBAL VILLAGE
COMMUNICATION

On-Line Discovery

One installation, lets you sample the leading Internet service providers and BBSs

On-Line Discovery software, from Global Village Communication™, is the first product to integrate five of the most popular on-line services—plus the Internet and bulletin board services—into one easy-to-use package. Take advantage of hundreds of FREE hours of on-line access time to try them all and decide for yourself which ones best suit your needs. From a single push-button interface you can communicate, send faxes, shop, work, learn and play on CompuServe, PRODIGY, American Online, GENIE, Reuters Money Network, bulletin board systems (BBSs), and the Internet!

- Try 5 of the most popular



commercial on-line services without purchasing and installing multiple packages

- Manage all of your on-line communications from a single push-button Communication Center
- Log on to thousands of BBSs, the popular forums devoted to a wide range of special interests, from a comprehensive directory.
- Send and receive faxes right from your computer
- Get up-to-the-minute market data and investment news with Reuters money network and financial management software.

\$29

On-Line Discovery 3.5" 215388

\$29

On-Line Discovery CD 215387

48

Insight awaits you on the World Wide Web! You can find us on the Internet at <http://www.insight.com>



KONEXX™

KONEXX Konnector

Your modem-to-digital phone connection. Don't "Tele-Fry" your new Fax/Modem.

The compact KONEXX Konnector is the ideal data communications products for executives, sales people and others who need high speed (up to 28.8KBPS) data communications in the field or office environments. You can connect your modem to virtually any digital, PBX, multiline and hotel telephone. You can quickly and easily create an RJ-11 jack at your telephone. Automatic switching between handset and modem makes this a perfect companion for contact management software, if your telephone system allows auto-dialing.



You eliminate the need for a costly analog line in the office. You can leave the Konnector installed, and use the telephone in its normal manner. For use in the field, the Model 111 has an easily replaceable 9-volt battery. For office use, it is shipped with an AC adapter. The battery is only used when the modem is in use, providing more than 15 hours of modem time with an alkaline battery.

\$139

Konnector Portable Model MBK0111

\$129

Konnector Desktop Model MBK0109

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\$189

Back-UPS Pro 280 PnP
with Powerchute Pro for Win '95
UPAPCBK 28P

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\$25,000

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UPS



Microsoft® SOLUTION PROVIDER

APC UPS & Surge Protector Models

Description	V/A	Product Code	Price
Back-UPS 200	200	UPAPCBK200	\$99
Back-UPS 280	280	UPAPCBK280	109
Back-UPS 400	400	UPAPCBK400	149
Back-UPS 450	450	UPAPCBK450	189
Back-UPS 600	600	UPAPCBK600	249
Back-UPS Pac 1000	1000	UPAPCB1000	399
Back-UPS Pac 1400	1400	UPAPCB1400	529
Back-UPS Pro 280 PnP	280	UPAPCBK28P	189
Back-UPS Pro 420 PnP	420	UPAPCBK42P	259
Back-UPS Pro 650 PnP	650	UPAPCBK65P	389
Smart-UPS 420 V/S	420	UPAPCVS420	239
Smart-UPS 650 V/S	650	UPAPCVS650	319
Smart-UPS 250	N/A	UPAPCSM250	239
Smart-UPS 400	N/A	UPAPCSM400	299
Smart-UPS 600	N/A	UPAPCSM600	369
Smart-UPS 900	N/A	UPAPCSM900	519
Smart-UPS 1250	N/A	UPAPCS1250	649
Smart-UPS 1400	N/A	UPAPCS1400	669
Smart-UPS 2000	N/A	UPAPCS2000	799
Smart-UPS 3000	N/A	UPAPCS3000	1,899

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UPBPSP660

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THE POWER PEOPLE



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Small, powerful, and microprocessor-controlled, BC models are the affordable UPS for small office/home office PCs. BC Personal features include long backup times, up-front LEDs to alert you of UPS and battery

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Internet BC 450
UP-BCI450

Tripp Lite- Uninterruptable Power Supply

Description	Volt/AMPS	Product Code	Price
BC Personal 200	200	UP-BCP200	\$99
BC Personal 280	280	UP-BCP280	109
BC Personal 420	420	UP-BC420	149
BC Personal 500	500	UP-BCP500	179
BC 450 Internet	450	UP-BCI450	159
BC Professional 550	550	UP-BCPR550	199
BC Professional 675	675	UP-BCP675	229
BC Professional 850	850	UP-BCP850	299
BC Professional 1050	1050	UP-BCPR1050	349

Best

Description	Volt/AMPS	Outlets	Mfr. Part #	Product Code	Price
Patriot 250	250V/A	2	SP250	UPBPSP1250	\$99
Patriot 400	400V/A	4	SP1400B	UPBPSP1400	129
Patriot 600	600V/A	4	SP1600B	UPBPSP1600	239
Patriot 850	850V/A	4	SPS850B	UPBPSP1850	419
Fortress 360	360V/A	4	LI360B	UPBPSP360	349
Fortress 460	460V/A	4	LI460B	UPBPSP460	379
Fortress 660	660V/A	4	LI660B	UPBPSP660	389
Fortress 950	950V/A	4	LI950B	UPBPSP950	629
Fortress 1300	1300V/A	6	LII.3KB	UPBPSP1300	879



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Processors

improve *it* technologies

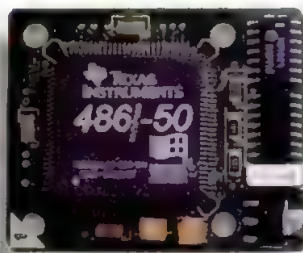
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Windows 95
COMPATIBLE



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186SX
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Improve it Technologies

Product Description	Product Code	Price
Make-it 486 (286 to 486)	286T0486	\$99
Make-it 486 (286 to 486) w/math coprocessor	286T0486/C	149
Make-it 486 (386 to 486), 386 SX	386T0486SX	99
Make-it 486 (386 to 486), 386 DX	386T0486DX	99

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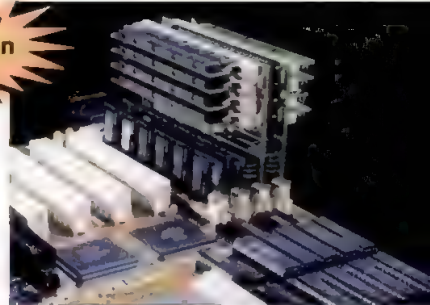
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SIMMexpanders

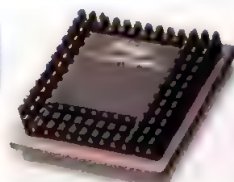
Product Description	Product Code	Price
Connects 4 30-pin SIMMS into 1 72-pin SIMM socket (forward)	SMM72430F	\$59
(backward)	SMM72430B	59
Connects 8 30-pin SIMMS into 1 72-pin SIMM socket (forward)	SMM72830F	79
(backward)	SMM72830B	79
Connects 2 72-pin SIMMS into 1 72-pin SIMM socket (forward)	SMM72272F	69
(backward)	SMM72272B	69
Connects 4 72-pin SIMMS into 1 72-pin SIMM socket (forward)	SMM72472F	89
(backward)	SMM72472B	89
Connects 4 30-pin SIMMS into 1 30-pin SIMM socket (forward)	SMM30430F	39
(backward)	SMM30430B	39

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Windows 95
COMPATIBLE



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DX2 OverDrive™	16/20/25MHz i486SX's	DX2ODP50	\$125
DX2 OverDrive™	33MHz i486 DX's	DX2ODP66	149
DX4 OverDrive™	16/20/25MHz i486SX's	DX4ODP75	165
DX4 OverDrive™	16/20/25MHz i486SX's	DX4ODP100	205
Pentium®OverDrive™ (63MHz)	25/50MHz i486SX/DX's	ODPEN63	259
Pentium®OverDrive™ (83MHz)	33/66MHz i486DX's	ODPEN83	269



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Notebook Memory Upgrades 4MB			8MB		16MB		32MB	
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Toshiba								
Satellite Pro 400	N/A	N/A	KTT400/8	\$499	KTT400/16	\$989	KTT400/32	\$1,949
Portege 610CT	N/A	N/A	KTT610/8	540	KTSP16MB	1,050	KTT610/32	2,039
T2110, T2130, T2150	KT21004MB	\$229	KT21008MB	419	KT210016MB	869	N/A	N/A
AST Ascentia								
900N, 910N	KT315475	\$219	KT315472	\$439	KT315476	\$859	N/A	N/A
950N	N/A	N/A	KTA950N/8	429	KTA950N/16	719	N/A	N/A
NEC								
2000C, 2000D	KT353010	\$195	KT347302	\$325	KT347303	\$695	N/A	N/A
Epson ActionNote								
866, 880, 890, 910	KTA882081	\$195	KTA882211	\$369	KTA882221	\$635	N/A	N/A
HP Omnibook								
600C	KT353034	\$239	KT353035	\$439	N/A	N/A	N/A	N/A
IBM ThinkPad								
755CD, 755CDV, 755CE								
755CSE, 755CV	KT260377	\$259	KT260378	\$479	KT260379	\$809	KT353004	\$1,599
755CX	KT315444	225	KT315445	419	KT315446	715	KT491790	1,345
701C	KTTP7014MB	225	KT353056	409	KT353057	765	N/A	N/A

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Size	Speed	Pin	Product Code	Price
2MB	70ns	30	PY1X8-70-2	\$89
2MB	70ns	30	PY1X9-70-2	99
2MB	70ns	72	PY512X32-7	96
2MB	70ns	72	PY512X36-7	122
4MB	70ns	30	PY1X8-2-4	\$185
4MB	70ns	30	PY1X9-3-4	208
4MB	70ns	72	PY1X32-70	179
4MB	70ns	72	PY1X36-70	195
8MB	70ns	30	PY4X8-70-2	\$332
8MB	70ns	30	PY4X9-3-2	359
8MB	70ns	72	PY1X32-7-2	389
8MB	70ns	72	PY1X36-7-2	389
8MB	70ns	72	PY2X32-70	339
8MB	70ns	72	PY2X36-70	379
16MB	70ns	30	PY4X8-70-4	\$636
16MB	70ns	30	PY4X9-70-4	699
16MB	70ns	72	PY2X32-7-2	675
16MB	70ns	72	PY2X36-7-2	765
16MB	70ns	72	PY4X32-70	599
16MB	70ns	72	PY4X36-70	649
32MB	70ns	72	PY4X32-7-2	\$1,199
32MB	70ns	72	PY4X36-7-2	1,414
32MB	70ns	72	PY8X32-70	1,221
32MB	70ns	72	PY8X36-70	1,414
64MB	70ns	72	PY8X32-7-2	\$2,409
64MB	70ns	72	PY8X36-7-2	2,839

High Density Standard SIMMs

72 PIN Modules	Speed	Size	Product Code	Price
512 x 32	70ns	2MB	PY512X32-7	\$96
512 x 36	70ns	2MB	PY512X36-7	122
4 x 32	70ns	16MB	PY4X32-70	599
4 x 36	70ns	16MB	PY4X36-70	649
8 x 32	70ns	32MB	PY8X32-70	1,221
8 x 36	70ns	32MB	PY8X36-70	1,414

Special Buys on Standard SIMMs

30 PIN Modules	Speed	Size	Product Code	Price
1 x 8	70ns	1MB	PY1X8-2	\$47
1 x 9	70ns	1MB	PY1X9-3	52
4 x 8	70ns	4MB	PY4X8-2	156
4 x 9	70ns	4MB	PY4X9-3	181

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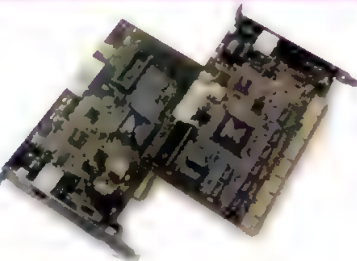


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**Fast EtherLink
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3Com's leadership in Ethernet and enterprise-wide Fast Ethernet solutions ensures you a smooth migration to high-speed networking.

By "future-proofing" your high-performance PCs and servers with dual-speed Fast EtherLink® PCI and EISA 10/100 adapters, you can run at the fastest data throughput rates in both 10BASE-T and 100BASE-T environments. Simply connect the adapters to a 10BASE-T hub now, and migrate to a 100BASE-TX hub when you're ready. There's no need for any adapter hardware or software changes.

\$239Fast EtherLink 10/100 EISA
NW3C597TX**\$225**Fast EtherLink 10/100 PCI
NW3C595TX**EtherLink® III Parallel
Tasking® adapter****Your bus just came in!**

The EtherLink III adapter family, the new EtherLink III PCI adapter uses 3Com's exclusive Parallel Tasking technology to provide unmatched real-world performance and reliability.

And when you add in the EtherLink III PCI adapter's bus mastering for low CPU utilization, you have the best performing adapters for PCI bus computers.

It's guaranteed compatible with PCI-compliant machines, or your money back. And the EtherLink III PCI adapter features the same AutoLink™ one-step installation, SNMP manageability, and lifetime warranty that you get with all EtherLink III adapters.

\$139EtherLink III PCI
NW3C590TP**3Com Networking**

Description	Prod. Code	Price
Ethernet, PC Card (PCMCIA)		
Etherlink IIIB PC Card, Combo	NW3C589BC	\$199
Etherlink IIIB PC Card, 5 pack, Combo	NW3C589BC5	899
Etherlink IIIB PC Card, TP	NW3C589BTP	155
Etherlink IIIB PC Card, 5 pack, TP	NW3C589BT5	699
Ethernet, ISA/EISA		
Etherlink III ISA, BNC	NW3C509B	\$109
Etherlink III ISA, 5 pack, BNC	NW3C509B5	469
Etherlink III ISA, 20 pack, BNC	NW3C509B2	1,699
Etherlink III ISA, TP	NW3C509BTP	107
Etherlink III ISA, 5 pack, TP	NW3C509BT5	439
Etherlink III ISA, 20 pack, TP	NW3C509BT2	1,579
Etherlink III ISA, Combo	NW3C509BC	121
Etherlink III ISA, 5 pack, Combo	NW3C509BC5	509
Etherlink III EISA, BNC	NW3C579	225
Etherlink III EISA, 5 pack, BNC	NW3C5795	899
Etherlink III EISA, TP	NW3C579TP	225
Etherlink III PCI, TP	NW3C590TP	139
Etherlink III PCI, Combo	NW3C590-C	159
Ethernet, Fast		
Fast Ethernet 10/100, PCI, TP	NW3C595TX	\$225
Fast Ethernet 10/100, EISA, TP	NW3C597TX	239
Ethernet, Hubs		
Linkbuilder Hub, 12 port, TP	NW3C16170	\$319
Linkbuilder Hub, FMS, 12 port, TP	NW3C1627-1	629
Linkbuilder Hub, FMS II, 24 port, TP	NW3C16671	869
Linkbuilder 100MBPS FMS, 12 port, TP	NW3C250TX	1,949
LinkSwitch 1000, 24 port, TP	NW3C16900	3,299
Token Ring, PC Card/ISA/EISA		
Tokenlink III PC Card 16/4	NW3C689	\$369
Tokenlink III PC Card 16/4, 10 pack	NW3C61910	2,199
Tokenlink III 16/4 ISA	NW3C619B	239
Tokenlink III 16/4 EISA	NW3C679	519
Tokenlink III 16/4 EISA, 5 pack	NW3C6795	2,449

Accessories

Description	Prod. Code	Price
Patch Cables		
Coax, 10'	NWCOAX-10	\$5
Coax, 15'	NWCOAX-15	6
Coax, 25'	NWCOAX-25	8
Coax, 50'	NWCOAX-50	15
TP or RJ-45, 7'	NWRJ45-7	5
TP or RJ-45, 10'	NWRJ45-10	6
TP or RJ-45, 14'	NWRJ45-14	7
TP or RJ-45, 25'	NWRJ45-25	10
TP or RJ-45, 50'	NWRJ45-50	15
TP or RJ-45, 100'	NWRJ45-100	30
Terminators/Connectors		
BNC Terminator Cap, 10 pack	NWTERM10	\$19
BNC "T" Connector, 10 pack	NWTCN10	19

ROM

Description	Prod. Code	Price
Boot ROM		
Kingston Remote Novell PROM	KT167496	\$29
3Com Boot ROM for 3C5X9 series	NW3C509-NW	49
Intel Boot ROM	NWINTB8100	49
SMC Universal Boot ROM for Etherez	NWSMCUROM	39

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Kingston

TECHNOLOGY CORPORATION

Kingston

Description	Prod. Code	Price
Ethernet, ISA		
Etherx 2121+, Combo	KT263245	\$70
Etherx 2121+, 6 pack, Combo	KT263246	419
Etherx LC, TP	KT342940	35
Etherx LC Combo	KT342943	39
Etherx 2100T+	KT263239	55
Etherx 2100T+, 6 pack	KT263240	295
Etherx 2102+	KT263242	65
Etherx 2102+, 6 pack	KT263243	365
Ethernet, Hubs		
Etherx Hub, 8 TP, 1 BNC	KT167470	\$105
Etherx Hub, 16 TP, 1 AUI, 1 BNC	KT233268	229



intel



Intel EtherExpress™ Pro Adapter

Description	Product Code	Price
EtherExpress Pro/10, ISA	NWINT8200	\$115
EtherExpress Pro/10, ISA, 5 pack	NWINT82005	489
EtherExpress Pro/10, ISA, 20 pack	NWINT82002	1,799
EtherExpress Pro/10, ISA, 80 pack	NWINT82008	6,499
EtherExpress Pro/10, ISA, FLASH	NWINT8205	129
EtherExpress Pro/10, ISA, FLASH, 5 pack	NWINT82055	527
EtherExpress Pro/10, ISA, FLASH, 20 pack	NWINT82052	1,965
EtherExpress Pro/10, ISA, FLASH, 80 pack	NWINT82058	6,999
EtherExpress Pro/100, PCI	NWINT8465	215
EtherExpress Pro/100, PCI, 5 pack	NWINT84655	999
EtherExpress Pro/100, PCI, 20 pack	NWINT84652	3,149
EtherExpress Pro/100, EISA	NWINT8265	255
EtherExpress 16TP RJ-45	NWINT16TP	99
EtherExpress 16 Coaxial	NWINT16	99
EtherExpress 16C Combo.	NWINT16C	119
EtherExpress FlashC LAN Combo. Card w/RJ-45, Thick/Thin Coaxial	NWINTFLSHC	125
5-Pack for FlashC	NWINT81205	619

SMC



EtherEZ ISA Ethernet Adapter Combo Model

SMC's EtherEZ™ Ethernet adapters are so simple to install and use, they go beyond Plug and Play! These 16 bit ISA adapters support the Plug and Play (PnP) specification, making them fully auto-configurable in a PnP computer—simply install the adapter and power up. No more fussing with jumpers to resolve conflicts, no more guessing which settings are already in use: the EtherEZ adapter and your PnP system automatically allocate an available

I/O base address and IRQ. And with SMC's included EZStart™ utility, these adapters can be configured in just one step in a non-PnP computer. Ethernet adapter installation has never been so easy! Installation takes less than 30 seconds and outstanding performance is achieved through SimulTasking™ technology.

Software driver installation has never been easier either. EtherEZ drivers support all your existing SMC/WD EtherCard adapters. And software driver updates are easier too—there's no need to keep track of which driver goes with which SMC adapter.



\$89 EtherEZ Network Coax Card
NWSMC8416B

\$89 EtherEZ Network TP Card
NWSMC8416T

\$99 EtherEZ Network Card Combo
NSMC8416BT

Networking



Xircom

THOMAS•CONRAD
CORPORATION



National
Semiconductor

Networking Solutions

Xircom Description	Product Code	Price
PC Card (PCMCIA) Ethernet Adapter	NWXCE210BC	\$199
PC Card (PCMCIA) Ethernet Adapter	NWXCE2BTP	149
PC Card (PCMCIA) Ethernet/Modem Adapter	NWXCDM210B	439
PC Card (PCMCIA) Ethernet/Modem Adapter	NWXCEM2TP	429
PC Card (PCMCIA) Token Ring Adapter	NWXTRIIPS	399
Pocket Token Ring Adapter III	NWXRPT16B3	449
Pocket Ethernet/Modem Adapter	NWXPEM10BT	449
Pocket Ethernet/Modem Adapter	NWXPEM10B2	449

Thomas Conrad Description	Product Code	Price
Ethernet, PCI	NWTC5048T	\$149
Ethernet, PCI, 6 pack	NWTC5048T6	769
Token Ring, ISA	NWTC4043	399
Token Ring, EISA	NWTC4047	599

National Semiconductor Description	Product Code	Price
ISA Network Card, RJ-45, 10/100 MBPS Ethernet	NWNS10/100	\$179

SMC Networking

Description	Product Code	Price
EtherEZ Network TP Card	NWSMC8416T	\$89
EtherEZ Network TP Card, 5 pack	NWSMCEZT5	379
EtherEZ Network TP Card, 20 pack	NWSMCEZT20	1,325
EtherEZ Network Coax Card	NWSMC8416B	89
EtherEZ Network Coax Card, 5 pack	NWSMCEZ5	419
EtherEZ Network Coax Card, 20 pack	NWSMCEZ20	1,599
EtherEZ Network Combo Card	NSMC8416BT	99
EtherEZ Network Combo Card, 5 pack	NWSMCEZC5	479
EtherEZ Network Combo Card, 20 pack	NWSMCEZC20	1,699

Token Card Elite 16/4 ISA	NWSMCE16/4	\$249
Token Card Elite 16/4 MCA	NWSMCE16M	249

EtherPower 10/100 PCI	NWSMC9332	\$199
EtherPower 10/100 PCI, 5 pack	NWSMC93325	959
EtherPower 10/100 PCI, 20 pack	NWSMC93322	3,699
EtherPower PCI, Combo	NSMC8432T	145
EtherPower PCI, Combo, 5 pack	NWSMCEPC5	679
EtherPower PCI, TP	NWSMC8432T	132
EtherPower PCI, TP, 5 pack	NWSMCEP5	579

Tigerhub 100 Fast Ethernet	NWSMC5116T	\$2,900
Tigerhub TP12 Ether Hub, 12 TP	NWSMCTP12	359
Tigerhub TP6 Ether Hub, 6 TP, 1 AUI	NWSMCTP6	165
Tigerhub TP6B Ether Hub, 6TP, 1 BNC	NWSMCTP6B	199
TigerStack NMM SNMP MGMT Module	NWSMC3300N	445
TigerStack 3328T Ether Hub, 28 Port, RJ-45, TPN	NWSMC3328T	925
Tigerswitch XE 24 Port Switch	NWSMCXE124	6,975



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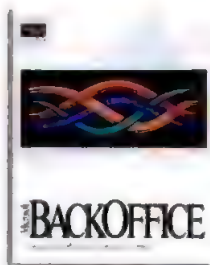


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MS Windows NT Server Value Pack 215786

Windows NT Workstation

Microsoft Windows NT Workstations are the most powerful desktop operating system for your most demanding business needs. Run high-end, 32-bit applications for software development, engineering, financial analysis, scientific, and business-critical tasks along with other Windows-based software, all in a secure, multitasking environment.

\$289

MS Windows NT Workstation CD 213716

Microsoft Products for Windows NT

Microsoft Products	Product Code	Price
Microsoft NT Workstation 3.5 Version Upgrade CD	213445	\$89
Microsoft Windows NT 3.5 Workstation Version Upg. 3.5"	213968	89
Microsoft Windows NT 3.5 Workstation License Pack	213405	249
Microsoft NT Server Version 3.5 Server CD	213447	649
Microsoft Windows NT 3.5 Server 20 User License	213370	509
Microsoft Office 4.2 Windows NT Comp. Upg. CD & 3.5"	213548	279
Microsoft Office 4.2 Windows NT CD & 3.5"	213689	469

CHEYENNE

for Windows NT

InocuLAN for Windows NT

InocuLAN for Windows NT is a 32-bit, multi-threaded, client/server anti-virus solution for the Windows NT network, including Windows NT servers and workstations as well as connected or stand-alone Windows, DOS, and Macintosh workstations. Operating as a system service, InocuLAN provides powerful administrative and removable management features with an intuitive Windows 95-style user interface. The Alert features supports notification through e-mail, network broadcast, alphanumeric pager, print, and SNMP trap.

InocuLAN employs an NCSA certified scanning engine to identify more than 90% of all known viruses, including multipartite, stealth, and polymorphics. InocuLAN also monitors for virus-like behavior to detect previously unidentified viruses. Upon detection, pre-defined administrative action is executed to delete, rename, cure, move or purge the infected file. All virus incidents, configuration changes, and operational results are recorded in the Windows NT event log.

\$549

InocuLAN for Windows NT 215825

ARCserve for Windows NT

Operating as a system service, ARCserve for Windows NT is a 32-bit, multi-threaded, client/server backup and data storage product which provides secure, unattended operations for the Windows NT network. ARCserve's Windows 95-style user interface provides intuitive access to a powerful set of features, including centralized management, flexible scheduling and scripting, selectable verification options, open/skipped file handling, anti-virus scanning, and Intelligent Restore options. The Alert feature supports notification through e-mail, network broadcast, alphanumeric pager, print, and SNMP trap. Exceptionally high performance and automation are delivered through parallel streaming to multiple tape devices and by cascading/grouping drives on a single or multiple con-



trollers. Optional autochanger support is also available for high capacity, lights-out operations. Optional database agents provide online backup of database servers, and optional client agents provide native support for other operating systems, such as NetWare servers, attached to the Windows NT network.

\$799

ARCserve for Windows NT 215735





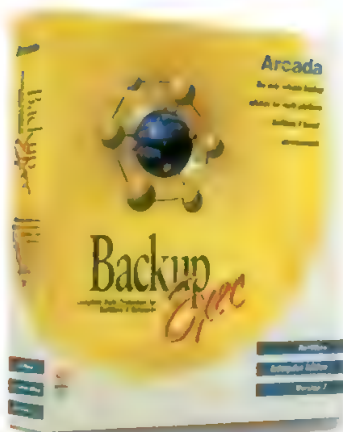
Arcada

Backup Exec for Windows NT Enterprise and Single Server Edition

Any client, any platform—Backup Exec delivers tested and proven protection

Backup Exec for Windows NT is the only field-tested and proven 32-bit backup solution for the complete Windows NT network. With centralized administration and its exclusive ExecView™ monitoring console, only Backup Exec provides true client/server functionality for your Windows NT backup. No other product offers more comprehensive features for data protection and reduced administration overhead. Only Backup Exec is the only data protection solution to provide complete, integrated support for Microsoft BackOffice. In fact, Microsoft selected Arcada to protect over 1,300 Windows NT servers worldwide.

Centralized administration and the exclusive ExecView™ monitoring console enables you to manage multiple servers or clients anywhere on the network. Remote administration allows you to manage remote sites with the same high performance functionality used to manage on-site servers. Point-and-Click scheduling fully automates unattended backup for all servers and/or workstations enterprise-wide.



- Windows NT Remote System Services (RAS) allows you to perform remote administration for network-wide management.
- Windows NT System Services provide transparent backup with no log-on required.
- Advanced Autoloader support allows complete unattended backup for large environments. (optional)
- Multi-drive concurrent backup support allows multiple jobs to run simultaneously.
- 100% compatible with the Windows NT standard—Microsoft Tape Format (MTF).
- Migration to Windows NT is simplified with Backup Exec's ability to read ARCserve for NetWare 4x and 5x, SyTOS Plus for OS/2, and Maynard tapes.
- Macintosh and UNIX agents provide complete client protection. (optional)

\$399

Backup Exec 6.0 NT CD 215354

\$749

Backup Exec 6.0 NT Enterprise Edition 215352

Backup Exec Netware 7.0 Enterprise Edition

The most complete, reliable NetWare 4 enterprise backup solution available

Give your company's data the maximum protection it deserves. Backup Exec provides all the tools you need to protect your network data now—without incurring any hidden costs later as your network grows. Fully supports virtually all types of servers and workstations that can connect to NetWare for true enterprise data protection. Backup Exec's speed, functionality and performance earned it LAN Magazine's "Product of the Year." Version 7.0 expands on this award-winning system for even greater peace of mind.

- Protect your data and namespace information on NetWare servers, including all objects and containers

within NetWare Directory Services (NDS)

- Manages up to 28 jobs simultaneously for greater productivity
- Reduces backup time with advanced compression technology
- SNMP support to report and manage error messages
- Automatic data backup for Windows 95-based Compaq Deskpro systems
- Directs backup to "next available" tape system for maximize performance
- Smooth migration to Backup Exec from other SIDS products
- Successful network backup regardless of hardware faults

\$289

Backup ExecNetware 7.0 25 User Single Server 215356

\$799

Backup ExecNetware 7.0 Enterprise Edition 216624

\$399

Backup Exec Netware 7.0 Single Server Unlimited Users 215355

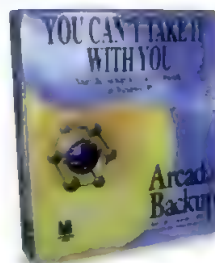


Arcada® backup for Windows 95

Tape drive/ Windows 95 users: You need new backup software to prevent data loss!

Your old Windows 3.1 backup software will not work on the new Windows 95 system. Prevent data loss—order the new Arcada Backup for Windows 95 from Insight today. Works with all floppy, parallel, IDE and SCSI tape drives. Built-in 32-bit

support assures maximum performance and reliability. Plus new Wizard technology saves you time, effort and your sanity... one click of the mouse backs-up and restores automatically. And installation is a breeze. Don't risk your critical Windows 95 data...order Arcada Backup for Windows 95 today for next business day delivery!



\$59

Backups Windows® 95 216887



800-488-0001

55

Need a server for your network? We're famous for being hard drive experts!—the selection begins on page 21.



It's Time To Upgrade

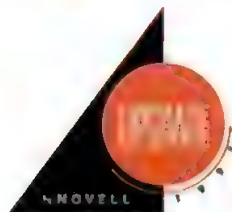
NOVELL Netware

Novell Netware 4.1 is the first and only Network Operating System to deliver the seven critical services needed in a fully integrated operating system:

- Distributed directory
- Multiprotocol
- Advanced Security features
- Complex print capabilities

- Messaging
- Total Management
- File Handling
- Easier to Install

Special 4.1
pricing until
10/31/95!



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Any 5 user	\$309 214815	\$1,299 214816	\$1,899 214817			\$269 214801	\$949 214802	\$1,549 214803			
Any 10 user		\$609 214818	\$1,349 214819	\$2,149 214820			\$499 214804	\$1,099 214805	\$1,749 214806		
Any 25 user			\$919 214821	\$1,749 214822	\$2,979 214823			\$749 214807	\$1,399 214808	\$2,399 214809	
Any 50 user				\$1,249 214824	\$2,499 214825				\$999 214810	\$1,999 214811	\$4,699 214812
Any 100 user										\$1,399 214813	\$3,999 214814
We also carry complete Netware packages!	Complete kit price										
	NW 3.12 5 user	NW 3.12 10 user	NW 3.12 25 user	NW 3.12 50 user	NW 4.1 100 user	NW 4.1 5 user	NW 4.1 10 user	NW 4.1 25 user	NW 4.1 50 user	NW 4.1 100 user	NW 4.1 250 user
	\$649 SWRD3NV32	\$1,399 SWRD3NV81	\$2,069 SWRD3NV62	\$2,799 214889	\$3,899 SWRD3NV91	\$639 214830	\$1,399 214859	\$2,149 214831	\$2,899 214833	\$3,999 214843	\$6,999 214846

We also carry
complete Netware
packages!

CHEYENNE

ARCserve® for NetWare

ARCserve for NetWare is the automated backup and restore solution for your entire Novell network. Using the MicroSoft Windows 3.1 Graphical user Interface, ARCserve Windows Edition manages backup easily.

ARCserve provides flexible automation capabilities to ensure that backup occurs when most convenient for the user.

FAXserve™

FAXserve™ is a high-performance, NLM-based network faxing solution that supports NetWare 4.1 Directory Services (NDS). Users may send and receive faxes directly from their workstations within any Windows, DOS, or e-mail application. Features intuitive Windows installation, drag and drop graphical fax manager, automatic cover pages, public and private 'phone books' and support for up to 32 fax lines.

\$679

FAXserve™ NLM 10 User
313660

\$239

ARCserve
NLM Windows 5 User
215736

\$459

ARCserve
NLM Windows 10 User
SWARCNLM10

\$839

ARCserve
NLM Windows 25 User
654831

InocuLAN

InocuLAN is a comprehensive server-based anti-virus program designed to protect your Novell network. InocuLAN protects both file servers and networked or stand-alone workstations against viruses. InocuLAN's NLM offers an unbreakable barrier designed to stop viruses in real-time, preventing viruses from getting into or out of your file server.

\$249

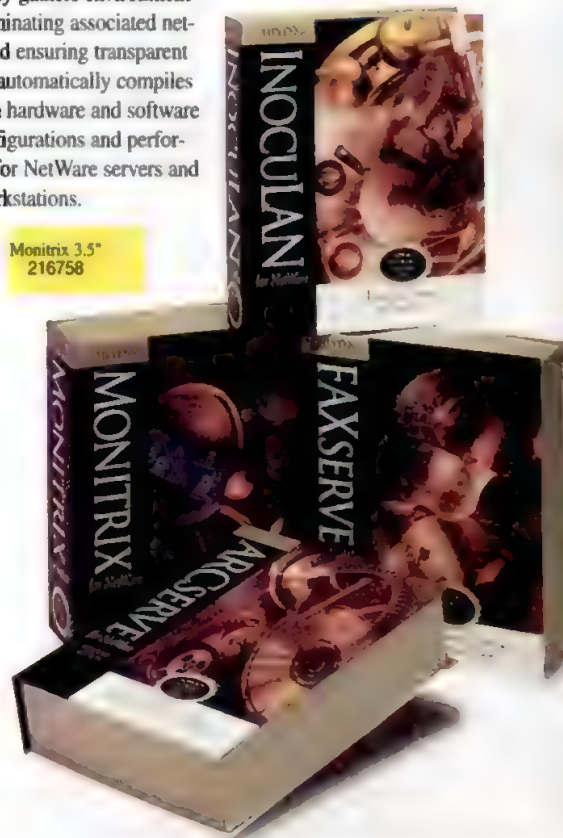
InocuLAN™ NLM 20 User
216625

MONITRIX

Monitrix takes an automated proactive approach to network management. Monitrix locally gathers environment statistics—eliminating associated network traffic and ensuring transparent operation and automatically compiles information on hardware and software inventory, configurations and performance trends for NetWare servers and networked workstations.

\$289

Monitrix 3.5*
216758



ARTISOFT®

**New Version
5.0!**

LANTastic® Network Operating Software

**Faster, easier
access to
everything—at
a fantastic low
price!**

Print and share files faster, work more intuitively and communicate better! Includes built-in e-mail and fax capabilities. Configure as peer-to-peer, dedicated server, or combination. Provides seamless access to existing networks including Novell®, IBM® and Microsoft®. Supports up to 500 users per server. Free tech support for registered users/resellers included.



\$139

LANTastic® Network
Operating Software 6.0
215464

Networking



LANTastic® Power Suite

**Six programs worth
\$650—all combined
in a single-user
pack for just \$152!**

- LANTastic
- Lotus cc:Mail
- Lotus Organizer
- Cheyenne Bitware
- Cheyenne BitShare
- NETCOM Netcruiser for the Internet

Install all six programs (except Netcruiser) in a single process. Intuitive and easy to use, Power Suite offers you instant productivity gains. Single user packs let you expand at your own pace and budget.



\$152

LANTastic® Power Suite
215464

Lotus cc:MAIL

**Get your company talking
with the world's most
popular LAN-based
e-mail!**

With over 5 million users, Lotus cc:Mail ranks as the most popular mail system in the world. Lotus

cc:Mail Desktop allows you to create and manage your own cc:Mail Post Office. Using Lotus cc:Mail allows your office to schedule appointments, speed communications and manage workloads faster and easier. Exchange messages, graphics, applications, and faxes with other cc:Mail users, regardless if they are users on DOS, Windows, OS/2, Macintosh, or UNIX.



Lotus Software

Product	Product Code	Price
cc:Mail Desktop 2.1 Windows	214590	\$65
cc:Mail Desktop 2.02 DOS	214593	65
cc:Mail Desktop 2.2 Mac	214596	65
cc:Mail Router 5.1	214891	65
cc:Mail Mobile 2.1 Windows	214567	129
cc:Mail Mobile 3.4 DOS	214566	129
cc:Mail Mobile 2.0.3 Mac	214598	129
cc:Mail Desktop 10 User License Pack	214597	549
cc:Mail Desktop 50 User License Pack	214591	2,649

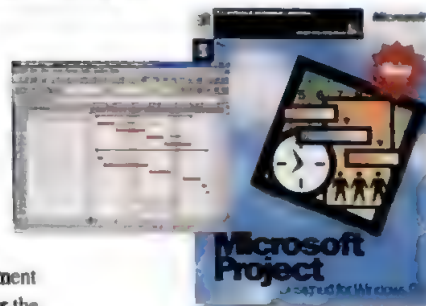
Microsoft®

Microsoft Project

**Plan, Manage, and
Communicate with
Ease**

Microsoft Project is the preferred product for comprehensive project management solutions. Now designed for the Windows® 95 operating system, it makes project management a natural part of your everyday business planning. So you can plan, manage, and communicate better to stay on schedule and on budget.

- For easy data entry: AutoCorrect, Spelling Checker
- Getting started: Quick Preview, Up and Running Tutorial, Templates, PlanningWizards, GanttChartWizard
- Tasks and resources: 9999 tasks per project, 9999 resources per project, recurring tasks, split tasks



- Multiple projects
- Constraints: ASAP, ALAP, SNET, SNLT, FNET, FNLT, MSO, MFO
- Tracking: Fixed costs, Percent-complete tracking, breakdown structure (WBS) codes, timesheets

\$129

MS Project Comp. Upg.
217226

\$419

MS Project 95
217227



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57



Input Devices

ALPS

GlidePoint® Keyboard

Windows keys with built-in touchpad

All the latest keyboard innovations packed into one sleek, sculptured design. Includes touchpad for fast and accurate point and click. Contoured wrist rest for hours of comfort. Special time-saving keys for Windows 3.1 and Windows® 95. Erase-Ease backspace key for increased productivity—and much more!



\$119

GlidePoint® Keyboard
216311

Desktop GlidePoint®

Get in touch with the 40% larger touchpad

Ideal for desktop users who want more touchpad room (4.35"x3.5") to slide and tap! Also includes detachable weighted base so you can adjust to just the right height and angle. Almost no moving parts will give you reliable performance for years—and it's warranted for life!



\$65

Desktop GlidePoint®
216312

TIMEX DATA-LINK WATCH

Wireless PC to Watch Communications

Join the Timex and Microsoft Revolution

A personal information manager on your wrist. Download information from your PC to the Timex Data Link watch. Select information from the Microsoft and Timex Data Link software, then simply point the watch at your PC monitor. The information, as flashing lines of light on your PC monitor, is read by the watch sensor. In seconds, up to 70 entries are loaded into the watch.

New styles coming! Ask your sales rep!



The Timex Data Link watch features:

- Appointments
- Phone Numbers
- Anniversaries
- To-Do-Lists
- Time Settings
- Alarms
- Works with Windows

\$99

Timex Data Link
Teal & Leather Band
215999

Timex Data Link

Product	Product Code	Price
Timex Data Link Watch-Black Band	215997	\$99
Timex Data Link Watch-Tan and Leather Band	215998	99
Timex Data Link Watch-Teal and Tan Leather Band	215999	99



58 Insight awaits you on the World Wide Web! You can find us on the Internet at <http://www.insight.com>



Microsoft®

MS SideWinder™ 3D Pro

The SideWinder™ 3D Pro joystick works with your Windows®-based and MS-DOS®-based games. The new high-powered digital mode adds enhanced precision and reliability when playing games for the Windows 95 operating system. New optical tracking eliminates drift problems found in standard analog joysticks.

- 3rd Degree of Freedom control
- Trigger
- Multiway hat switch
- Joystick buttons
- Base buttons
- Slide throttle



\$35

MS SideWinder™ 3D
216780

\$55

MS SideWinder™ 3D Pro
216785

MS EasyBall™

EasyBall™ helps kids use the home computer with confidence right from the start. And with EasyBall, you get Microsoft Explorapedia™ The World of Nature, an interactive encyclopedia for children.

- Friendly, comfortable design and improved cursor control
- Microsoft® Explorapedia™ The World of Nature
- EasyBall™ remains stationary so your child never runs out of room to



maneuver it on the desktop. The large ball requires less fine-motor control, which makes positioning the mouse cursor easier for young children

\$45

EasyBall trackball
216737

MS Natural Keyboard

Responsibly designed for maximum comfort following extensive ergonomic and usability research, the new Microsoft Natural Keyboard lets you work comfortably and more naturally positioning and supporting your hands, wrists, and forearms.



\$89

MS Natural Keyboard
213471

MS Mouse 2.0

The more comfortable, easier way to point your way through MS Office and other popular Windows programs. Versatile IntelliPoint mouse software lets you customize the way you work with Windows.



\$49

MS Mouse
1356195



NOVELL



PerfectOffice 3.0

Integrates the company's best-selling Windows applications into one computing solution

- The First Network Suite
- Powerful custom development tools
- Superior Program Integration and Automation
- Desktop Application Director (DAD)

- Common user interface (CUI)
- The best end-user and IS support in the industry
- The best choice for current WordPerfect, QuattroPro, and NetWare users
- Six months of toll-free technical support

Owners of WordPerfect, Presentations, Quattro Pro, Borland Office or NetWare qualify for this upgrade.

\$189

WP Perfect Office Std. Upg.
214609

\$419

PerfectOffice 3.0 Standard
214607

\$539

PerfectOffice 3.0 Professional
(Includes Appware and Paradox)
214606

The Perfect Place to Work

“Novell's PerfectOffice 3.0 sets the pace with excellent functionality and superb cross-application support. The result is a suite that leapfrogs the competition by placing its emphasis on tasks, not individual programs.”

-PC Magazine 2/21/95



WordPerfect 6.1 for Windows

The Perfect way to create better documents

\$89

WordPerfect 6.1 Ver. Upg.
214406



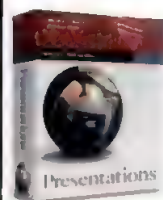
Any WordPerfect user qualifies for this upgrade!

Quattro Pro 6.0

The Perfect way to make your numbers count

\$49

Quattro Pro 6.0 Ver. Upg.
214234



Presentations 3.0 for Windows

The Perfect way to sell your ideas

\$119

Presentations 3.0 Comp. Upg.
213428



GroupWise 4.1

The Perfect way to share information

\$199

GroupWise 4.1 Win. Comp. Upg.
Client/Admin. Pack
214781



InfoCentral 1.1

The Perfect way to organize people, places and things

\$65

Info Central 1.1 Win.
461653



Envoy 1.0

The Perfect way to view any document

\$119

Envoy 1.0 Win.
214326



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Software

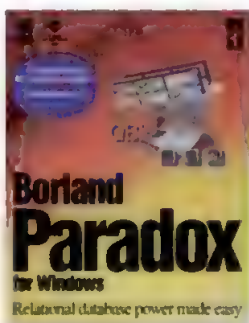
Borland

Paradox for Windows

The fast, powerful, award winning database for both users and developers

Whether you're an end user or a developer, new Paradox 5.0 combines ease of use, powerful client/server features, and a highly advanced Windows graphical user interface to make you instantly more productive. Even if you've never used a database before, Paradox's new Interactive Coaches turn you into a database expert in no time flat.

- Interactive Coaches for easy learning
- "Do-it-for-you" Experts
- More than 300 new methods and properties



- Independent debugger
- Now send e-mail directly from Paradox
- Additional field types for greater flexibility
- Excellent OLE support with suite products

\$329

Paradox 5.0 Win.
and Windows NT
214655

CLARIS

FileMaker Pro 2.1

Manage, present and share information

It's the most versatile database management tool available for individuals and workgroups. FileMaker Pro lets you instantly sort and search your data to generate mailing lists, prepare invoices and purchase orders, and manage a host of other functions from inventory to

sales reports and project tracking. Includes graphical data entry tools and point-and-click scripting.



\$129

FileMaker Pro 2.1
845522

Microsoft

Access for Windows 95
Rational database power for everyone

- **Easy to get started:** Start a database whatever way it works best—import an existing spreadsheet, have the Database Wizard prepare a new database from a selection of templates, and more. Even let the Table Analyzer Wizard automatically turn your flat file spreadsheets into powerful relational databases.
- **The answers you need:** Get simple answers with a mouse click using Filter by Selection; or ask complex And and Or questions with Filter by Form
- **Turn data into information:** Using the PivotTable Wizard from Microsoft Excel, add flexibility to your analysis of data from Microsoft



Access. Or merge data from Microsoft Access into a Microsoft Word mailing using the Mail Merge Wizard.

- **Build custom solutions quickly:** Use the shared development environment, Microsoft Visual Basic® for Applications and the support for OLE to create solutions rapidly.

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Access for Windows 95 Upgrade
217020

\$95

Access for Windows 95
Full Package
217021

Introducing the best ways to program for Microsoft Windows 95.

The newest developer tools from Microsoft are faster. More powerful. And ready to work with Windows® 95 and Windows NT™.

Visual FoxPro
The only Xbase product easy enough

to be visual, yet powerful enough to be FoxPro.

Now you can build powerful Xbase solutions today that leverage 16-bit Windows 3.1 as well as 32-bit Windows NT and Windows 95. Among its new features are: full object orientation, improved client-server capabilities, a powerful new data directory, and a greatly enhanced event model. Microsoft Visual



FoxPro, Professional Edition, is the essential tool serious developers need to build solutions for Windows 95 today.

\$179

Visual FoxPro 3.0 CD
215626

\$459

Visual FoxPro Pro 3.0 CD
215627

60

Can't find it? Call

Borland®

Delphi

The RADical development tool everyone's talking about

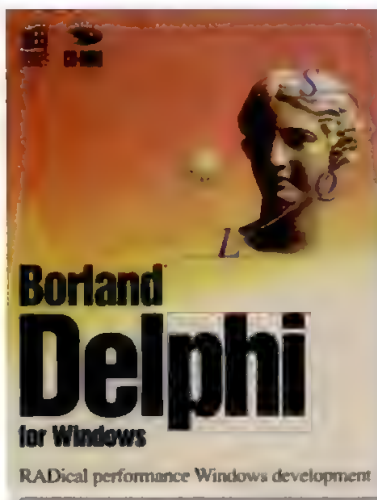
Delphi is the only Windows development tool to combine the Rapid Application Development (RAD) benefits of visual component-based design with the power of the world's fastest optimizing native-code compiler and scalable database access.

Local InterBase® Server so you can easily create SQL applications on your stand alone PC

The Borland® Database Engine so you can power applications with the award-winning engine behind Paradox and dBASE

Visual Component Library contains over 75 prebuilt, reusable components such as database controls, notebook tabs, grids

- ReportSmith, the award-winning reporting tool keeps you on top of any project with up-to-the-second reports generated from "live" data
- Object Inspector for access to all properties and events of any component
- Integrated Assembler
- WinSight™ and WinSpector™ to monitor Windows message flow and help avoid annoying GPFs
- Online Expert Help a unique interactive help system to start you developing right out of the box
- Graphical Browser: Graphical Debugger; Templates; Icon, Bitmap, and Menu Editors and much more, to save you time and work, and dramatically increase your productivity



- True Object-Oriented Programming (OOP) including polymorphism, inheritance, and encapsulation so you can deliver robust applications

\$349

Delphi CD
215506

Software

Borland C++



Create Windows® 95 & OLE 2.0 applications fast!

Developers the world over have long made Borland C++ their #1 choice. There's simply no easier, more powerful programming environment.

- Windows-hosted integrated Development Environment for writing DOS, Windows, and Win32s applications
- Lightning-fast C and C++ compiler for 16-and 32-bit DOS and Windows
- ObjectComponents Framework (OCF) for fast OLE 2.0 development
- Optimized 32-bit compiler for faster 32-bit applications
- AppExpert with point-and-click OLE 2.0 development
- Win32s, Windows 95, and Windows NT support for VBX controls
- ObjectWindows Library 2.5 with new OLE 2.0 classes
- Power Project Manager targets both 16-and 32-bit code generation

\$339

Borland C++ 4.5
SWRDCBL47

Microsoft®

Visual Basic® Version 4.0, Professional Edition
The key to unlocking Windows 95.

This programming system offers the best of both worlds. It allows you to maintain your users of Windows 3.x, while moving your development efforts to Windows 95. Effortlessly. New Visual Basic 4.0 Pro features exciting new OLE Controls such as Databound Grid, Databound List, and Databound Combo. Plus an updated Jet database engine to support replication, and 11 Windows 95 controls for



creating great applications for Windows 95 fast. You can step up to Visual Basic, Enterprise Edition—the easy way for teams to create distributed client-server solutions.

\$259

Visual Basic Pro 4.0 CMP & Ver. Upgrage
216241

\$469

Visual Basic Pro 4.0 Full Package
218992



Microsoft Visual C++™ 4.0.

No other development tool offers such reusability, so you can deliver more robust applications in less time

With Microsoft Visual C++ 4.0, you can create and reuse code and components, all with the latest Windows-based 32-bit technology.

In addition, this new development

system provides a powerful, tightly integrated tool set, including the Microsoft Foundation Class library: 70,000 lines of prebuilt, pretested code to get you on your way. And get a year's worth of timely updates with Microsoft Visual C++ Subscription.

\$269

Visual C++™ 4.0
216411



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61



Lotus

Lotus SmartSuite 4.0

The desktop solution for you and your team

Lotus® SmartSuite® for Windows™. It brings your most important desktop applications together. And it does the same for you and your team.

By integrating five of the hardest-working, easiest-to-use tools in business today—Lotus 1-2-3® spreadsheet, new Lotus Word Pro™ word processor. Lotus Approach® relational database, Lotus Freelance Graphics® presentation graphics and Lotus Organizer® personal information manager—SmartSuite helps you get the job done fast, whether you're working within applications or between them. And with features like

TeamConsolidate in Word Pro and Version Manager in 1-2-3, SmartSuite helps you and your entire organization reap the benefits of Team Computing. All by itself, or in tandem with Lotus Notes, the Groupware Standard, SmartSuite makes it easier than ever to collaborate with co-workers, clients, even suppliers.

Add it up, and you'll see why SmartSuite is the complete desktop solution for you and your team.

• Lotus 1-2-3 Release 5 spreadsheet for Windows

Winner of numerous software awards and accolades, Lotus 1-2-3 Release 5 is designed to streamline all of your everyday spreadsheet tasks. It offers maximum productivity, with minimum effort.

• Lotus Approach 3.0 database for Windows

Lotus Approach makes managing data as easy as 1-2-3. You don't have to be a programmer to use this

relational database for tracking sales, managing projects, creating reports and more.

• Lotus Word Pro, the first team word processor for Windows

New Lotus Word Pro gives you revolutionary new ways to create, review and edit documents, making you and everyone else on your team more productive.

• Lotus Freelance Graphics 2.1 presentation graphics for Windows

It's the fastest, easiest way to influence, persuade or inform at your next meeting—with great-looking on-screen presentations, handouts, flip-charts and more.

• Lotus Organizer 2.1 personal and group scheduler for Windows

There's simply no better way to schedule your appointments and manage your workload. Includes



calendar, to-do list, planner, address book, notepad, call manager and anniversary reminder.

• Lotus ScreenCam 2.0 for Windows

This powerful software turns your PC into a VCR that captures every click, scroll and action on screen with captions or the sound of your voice. Use it to create and distribute your own screen "movies" when you can't be there in person.

\$389

Lotus Smart Suite 4.0
CD Full Package
216484

\$199

Lotus Smart Suite 4.0
CD Upgrade
215617

Buy for today and tomorrow with the Buyer's Assurance Plan. Simply purchase any current Windows 3.1 version of our most popular desktop applications before December 31, 1995 and receive a free* license for our 32-bit Windows 95 or OS/2 Warp versions. You get productivity of Team Computing today and the freedom to take your time while you consider the future.

*Free upgrade license. Media and documentation can be purchased separately.

Lotus Organizer 2.0

Organize both yourself and your team!

Whether you work alone or in a group, Lotus Organizer helps you plan your day with an on-screen Calendar, To-Do list, Planner, Address Book, Call Manager, Notepad, and Anniversary reminder.



\$89

Lotus Organizer 2.0
214149

Word Pro 96

The team word processor

Lotus® Word Pro™ 96 Edition revolutionizes the way that people create, review, and edit collaborative documents. Designed as the first true Team Word Processor, it makes it easy to bridge the gap between an individual writer and team productivity.

Lotus Smart Word Processing innovations provide all the tools you need to create powerful persuasive documents.

- Spell checking all at once or as you type. SmartCorrect automatically fixes common typing mistakes on-the-fly
- Pre-formatted SmartMasters with "click-here" blocks for letters, memos, newsletters and more!
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Exceptional filters bring in all your current word processing files—



without losing formatting. Get the most of Working Together® with Lotus Word Pro 96 and its rich integration with Lotus SmartSuite and Lotus Notes®. Even share work over the Internet*! Plus, buy one copy and receive a second copy free! (Shipping and handling charges apply) And a \$20 rebate for users of any Lotus product. Special limited-time promotional price!

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Word Pro 96 3.5*
for Windows 3.1
215757



SYMANTEC.

ACT! for Windows 2.0

Simply the best way to manage your business relationships

- Create unlimited databases using 70 customizable fields to store all data
- Schedule unlimited calls, meetings, and to-do's to easily manage your calendar
- Choose from several predefined reports, for phone lists activities reports, address books, status reports, task lists, and more personalized correspondence
- Send and receive electronic mail messages, including contacts, activities, letters, and reports from within ACT!

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ACT! for Windows
SWRWDND04

\$239

ACT! Mobile link 2.0
215682

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Easy Business Cards

Do-it yourself professional-looking business cards

- Look professional create professional-looking business cards to enhance your image! Select from over 290 pre-designed business card styles or design your own.
- Save Time! Design and print cards in minutes! Designer paper stock to create your first 250 business cards included!
- Save Money! Eliminate costly graphic designer and color printing charges

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Easy Business Cards
216816

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One program does it all

ClarisWorks 4.0 is the smartest all-in-one-choice for business, home and education. It's a word processor, spreadsheet, database, drawing, painting and presentation maker. Now instead of learning a half dozen different programs, you just need to become familiar with one. Everything you need to produce professional letters, reports, budgets, presentations, proposals, flyers, mailing labels, term papers—and virtually everything else.

\$69

ClarisWorks 4.0
214204

Software



Peachtree
An ACT Company

Peachtree Accounting for Windows, Release 3.0



Manage your business, not just your books

Peachtree Accounting does more than manage your money, it actually helps you make more with an Action Items Center and a Manager's Series which alert you to the business information you need to build your business and increase your profits. Includes everything your growing business needs: General Ledger, Budgeting, Receivables, Invoicing, Payables, Payroll, Inventory, Job/Project Tracking, and Bank Reconciliation. Multi-user and network ready, right out of the box.

\$109

Peachtree Accounting 3.0 Win
SWRW3PE30

Peachtree First Accounting for Windows, Release



Getting started has never been easier

Peachtree First Accounting is the easy-to-use solution for involving customers and paying bills. This value-packed program includes everything a growing business needs to automate, including general ledger, accounts receivable, invoicing, accounts payable, checking account reconciliation, job tracking, payroll check printing and more.

- The basics for paying vendors, invoicing customers and managing your business
- Input screens look like the forms they represent
- Easy upgradability

\$45

Peachtree First Accounting
215415

Intuit

QuickBooks Pro

Just as easy and hassle-free as QuickBooks the #1 selling accounting software!



The fastest, easiest way to track projects and manage your business. QuickBooks Pro integrates time tracking, estimating and job costing with hassle-free accounting and payroll. It saves you time by putting more of your important business information in one place. You never have to enter the same information twice!

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QuickBooks Pro 3.1
216434

Quicken Deluxe 5

Make better financial decisions

New multimedia Quicken Deluxe expands Quicken, the fastest, easiest way to organize your finances—now with convenient online banking! Quicken Deluxe helps you make better financial decisions with a multimedia tour of the fundamentals of personal finance, expert financial advice tailored to your financial situation, a mutual fund finder to help you find the funds that meet your goals, and online stock news and research from the same sources Wall Street professionals use. Plus, you get home inventory management, a financial address book, and more.

\$119

Quicken Deluxe 5 CD
567842



Insight

800-488-0001

63

Software



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Great Value Accounting Package with contact management and much more

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CashGraf HomeOffice Plus 3.0
215430



CashGraf Business Plus

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CashGraf Business Plus has been designed from the ground up as the world's only single solution business and office software product... Productivity is the key, no other product or products are so seamlessly integrated, powerful and easy to use. Now you truly have a better alternative!

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CashGraf Business Plus 3.0
215412

Visio



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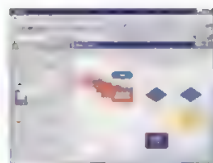
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Visio is the smartest way to create all your business diagrams because it does much of the work for you. It's so flexible, you can use just one program to create flowcharts, block diagrams, relationship diagrams, network diagrams, office layouts, maps, and much more. And it's optimized for Windows® 95.

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Visio 4 for Windows
216849

SOFT ONE



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ClassAct is not a slide show or video presentation. Only ClassAct offers 100% simulation. Only ClassAct has the technology to offer complete Office Suite training on one CD-ROM. Only ClassAct is a complete

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Class Act Windows 95 CD
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Office 95 CD
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\$115

Org Plus
SWRWDBE01

CRT Multimedia

Easy Tutor

The fastest way to learn Windows® 95

- A comprehensive guide developed by industry experts
- Use the animated storyboard in 'Concepts' to understand the benefits of Windows® 95
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view your progress using CRT Multimedia's new Intelligent Learning Technology™ (ILT™)

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Easy Tutor
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Adobe

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Offers dozens of powerful new features

Expand your publishing capabilities with Adobe™ PageMaker™ 6.0, the latest version of the world's leading professional page layout software. Now it's even easier to produce outstanding print and electronic communications. The Kodak Precision Color Management System in PageMaker 6.0 helps provide accurate and consistent color from start to finish. Multiple master pages let you apply different page designs easily, and grouping, locking, and masking offer even more design flexibility. For Internet

publishing and other electronic distribution, you can convert PageMaker publications to HTML and create Adobe Acrobat™ files. What's more, PageMaker comes packed with extra value—a free Type On Call™ CD-ROM, with 220 fonts unlocked upon registration, and a free Deluxe CD-ROM, with Acrobat Distiller, Adobe Photoshop™ LE, and much more. Now part of the Adobe publishing solution, PageMaker 6.0 offers dozens of powerful new features to help you work creatively without constraint or compromise.

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Adobe PageMaker 6.0 CD
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Software



Adobe Photoshop™ 3.0.1

The world's leading photo design and production tool!

Photoshop™ lets you design artwork with a wealth of powerful painting and selection tools, or retouch and correct true color or black-and-white scanned images with image-editing tools and filters. Includes ATM software. Includes Windows NT™ support, multiple layers feature, lighting effects, new color-correction tools, major user interface enhancements and the Type On Call™ CD-ROM.



Adobe Photoshop 3.0

Free Deluxe CD-ROM contains interactive tutorials, stock photos, third-party filters, Adobe Acrobat Reader software and more.

\$579

Adobe Photoshop 3.0.1
SWRW3AOB3

QuarkXPress for Windows

The page layout application professional publishers depend on!

- Seven movable, on-screen palettes for modifying items, arranging pages, and more
- Four-color separations from within QuarkXPress with built-in trapping tools
- Unequaled typographic controls — specify type from 2 points to 720

points, and kern and track text to .000005 em space

- Import all popular picture formats, including Mac and PC EPS DCS 1.0 formats: scale, crop, rotate, including Microsoft® Word, Word Perfect®, and XyWrite®
- Unlimited publishing flexibility through third-party XTensions™

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QuarkXPress 3.31 Win
SWRW3MI74



Deneba Software

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Cross-Platform Graphics Powerhouse!

The most powerful graphics program in illustration. Buy Canvas 3.5 and get a free upgrade to Canvas version 5 FREE. That's a savings of \$200! Create precisetechnical illustrations, stunning graphic designs, dynamic business presentations, and awesome page layouts with Canvas 3.5. Novices and experts alike will love Canvas' easy-to-use, but powerful Bézier drawing tools, blends and gradient fills. Canvas also includes integrated bitmap image editing features, plus a bonus CD-ROM with 10,000 vector clip art images and 2,000 TrueType fonts.

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Canvas 3.5 Windows Full Package
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Canvas 3.5 Windows Cmp. Upg.
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The Print Shop® Deluxe Ensemble™ II enables users to create and print eleven versatile projects, including greeting cards, signs, banners, certificates and much more. Access over 4,500 graphics at the touch of a fingertip with Ensemble II's powerful Graphics Browser and even select graphics by theme to create printing solutions for your home, business, or educational needs. Includes over 200 inspirational quotations, verses, phrases, and hundreds of ready-to-print designs that can be customized to suit your needs or used to give you creative ideas.

With over 3,500 combinations of text shapes and styles to create special effects, a 256 color palette, hundreds of layouts that suggest the best placement of text and graphics, and photo CD support, the design possibilities are endless!

Performs under both Windows 95 or Windows 3.1.

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Print Shop Deluxe
215837



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Get a good look at your designs with a new monitor. You'll find them starting on page 35.



MACROMEDIA®

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Everything you need to turn your creative ideas into breathtaking reality: four of the most widely used applications for design and illustration, font creation and editing, 3D modeling and rendering, and paint and image editing. Together they give you the power to realize your artistic vision. And from there the opportunities are endless.

• FreeHand 5.0

The most powerful tool available for design and illustration. Its comprehensive feature set, customizable working

environment, superior performance, and ease of use make it a tool of choice worldwide. FreeHand has the power you need to develop every thing from simple illustrations to complex designs.

• MacroModel 1.5

Gives you the power to bring your designs into the third dimension. Its fast, spline-based, CAD-accurate, tools let you quickly create 3D models from 2D objects. Its wide range of capabilities, including real-time editing and rendering, and its extensive modeling tools, make MacroModel ideal for creating 3D illustrations for desktop publishing,

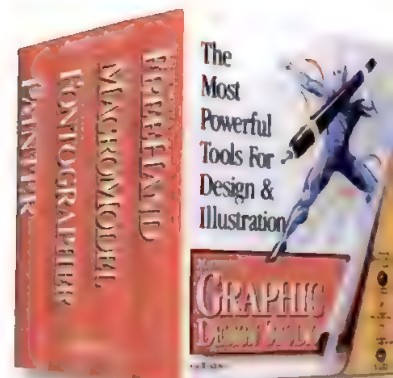
product prototyping and multimedia production.

• Fontographer 4.1

The easiest most powerful way to modify and create fonts. Novice graphic artists can take advantage of its ease of use for impressive results, while professionals can exercise complete control over every characteristic of a typeface with the program's precision drawing tools and advanced capabilities.

• Fractal Design Painter 3.1

The powerful paint and image editing program that simulates the tools and textures of natural



and "supernatural" media. From pencils and crayons or water colors and oils to airbrushes and extraordinary special effects, Painter turns your computer into an artist's studio—including rotoscoping and frame-by-frame animation.

\$629

Graphic Design Studio
216818



Compatible
with:
**Windows 95,
3.1 and NT**

FreeHand 5.0

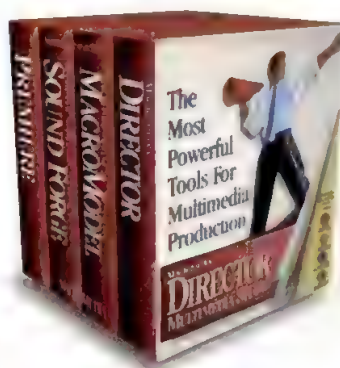
Macromedia FreeHand 5.0 has a comprehensive feature set, customizable working environment and superior performance making it the tool of choice for graphic designers, creative directors, production artists and illustrators worldwide. FreeHand's open architecture allows you to take advantage of drop-in interactive tools and palettes in addition to third party plug-ins. FreeHand's extensive text handling capabilities, including: style sheets, spelling checker, search and

replace, text on a path, copyfitting, columns, and linked text blocks, surpass those found in any other design and illustration package.

- Special effects tools include: Fisheye Lens, Eyedropper, 3D Rotation, and Smudge
- 100 step undo and redo
- Unlimited layers
- Smooth blends and automatic rebends
- Drag and drop colors and styles
- Multiple page layouts
- Trapping tool

\$379

FreeHand 5.0 CD
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Director 4.0.4

Macromedia Director 4.0.4 is the industry standard multimedia authoring tool for creating and distributing interactive applications, professional multimedia presentations, and animations. Create stunning presentations to technical visualizations, multimedia kiosks, and title development.

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- Create 2D professional animation
- 8-bit paint and animation tools
- Lingo scripting language
- Visual timeline
- Two sound channels

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Director 4.0.4 CD
215457

Director Multimedia Studio

Everything you need to create your own multimedia presentations is included with Director Multimedia Studio.

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The premier multimedia authoring tool

• MacroModel 1.5

The most powerful modeling tool for 3D professionals

• Sound Forge

Record, convert, and create sound files

• Adobe Premier 4.0

Create high-quality digital video movies

• Extreme 3D (available fall 1995)

For 3D modeling, animation, rendering, and composing

Ask your Sales Rep about additional Macromedia Bundles

While supplies last

\$1,349

Director
Multimedia Studio
215800

Insight is a
NASDAQ
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Import original images with your own color scanner. See page 40 for the selection.



CorelDRAW 6

The world's premier 32-bit Windows® 95 graphics application

With the speed and accuracy of 32-bit architecture, CorelDRAW 6 provides precision to 0.1 micron, multi-threading, multi-tasking and a workspace of over 150 feet by 150 feet. Support for a Multi Document Interface (MDI) allows users to open several documents at once or multiple views of a single document. CorelDRAW 6 has a fully-customizable user interface allowing easy organization of toolbars,

hotkeys, roll-ups and status bars, plus Wizards and Tutor Notes. CorelDRAW 6 offers fully-featured software applications for illustration, photo-editing and bitmap creation, business and multimedia presentations and 3D rendering.

- CorelDEPTH—3D logo creation application
- Corel MOTION 3D—a utility used to create broadcast-quality flying logos and movies
- Corel Multimedia Manager—a utility used to manage and manipulate files visually in an album metaphor



Corel GALLERY 2

Corel Gallery 2 is the ideal partner for any desktop publishing application. An incredible value, Gallery 2 includes an "Album" containing 15,000 clipart images, 500 fonts, 500 photos, 75 sounds, and 10 video clips. Using Gallery 2 and OLE 2.0, these items can be dragged and dropped into (or converted for use with) any word processing, presentation, page layout, or graphics application. Includes viewing and conversion utilities.

\$65

Corel Gallery 2 CD
215322

- Corel OCR-TRACE—an optical character and raster to vector conversion application
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- Corel Font Master—a complete font manager program
- CorelSCRIPT—and OLE 2 scripting language used to create add-on utilities for CorelDRAW 6
- Corel Dialog Editor—a utility used to create dialogues to be used in conjunction with CorelSCRIPT

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CorelDRAW 6 Win 95 CD
217680

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CorelDRAW 6 Win 95 Upg CD
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Corel CD Office Companion

It's a fax, Internet browser, dictionary, time manager, encyclopedia, graphics source, address book, financial tracker and much more—all on one CD! Here are a few gems on the Corel CD Office Companion you'll never want to be without: CorelFLOW Business Graphics, Spyglass Enhanced Mosaic, CorelFAX, Corel GALLERY 2, Corel PLANNER, plus a dictionary, encyclopedia, contemporary quotations, Information Please 1995 almanacs, and much more!



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Corel CD Office Companion
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Corel Wild Cards

Playing cards has never been this much fun! Your child will enjoy hours of endless fun on the computer playing with hilarious, fully-animated cartoon opponents. Also includes exciting activities such as painting, creating banners, sandwich making, doll making and silly hot spot animations. Seven great card games to teach such skills as simple math (pre-math), shape and number recognition, logical thinking skills, and important social skills.



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Corel Wild Cards
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Bernard of Hollywood's Marilyn

Bernard of Hollywood's Marilyn is a photographic account of Marilyn Monroe's life through the eyes of legendary photographer Bruno Bernard. Explore a time-line account of Marilyn's life through in-depth interviews, photographs and newsreel footage. With text and narrative by Susan Bernard, this multimedia CD-ROM biography is a "must-have" collector's item for all of Marilyn's devoted fans.



\$45

Bernard of Hollywood's Marilyn
216476

Adventures with Edison

Including three challenging games—Mystery at the Museums, Wild Science Arcade and Rock and Bach Studio—Adventures with Edison provides your kids with hours of stimulating entertainment. Each game has superb animations with 3D high-resolution graphics, digitized sound and dazzling 256-color Super VGA graphics. Different skills levels make it perfect for all ages!



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Adventures with Edison
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All-Movie Guide

The Corel All-Movie Guide gives you interactive access to the world's largest movie database with over 90,000 movie and video listings on CD-ROM. Print a list of movies to take to the video store, or purchase a video from the wide variety of movies included in the All-Movie Guide's home delivery service.



\$45

All-Movie Guide
215316

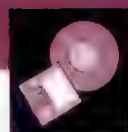
Print your images in dazzling color! See pages 41&42 for color printers from Epson and Canon.



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67

Software



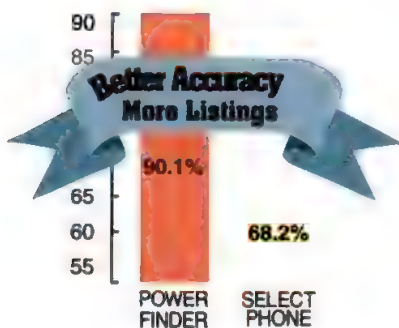


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More Listings! More Power!

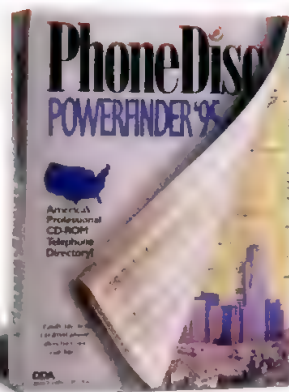
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"PhoneDisc® had an overall accuracy rate of 90.1% ...SelectPhone from Pro CD had a dismal accuracy rate of 68.2%" -*Computer Technology Review 6/95*

PhoneDisc data is gathered here in the USA using a state-of-the-art optical scanning and OCR process that eliminates thousands of typos found in other directories that key the information in by hand, the old fashioned way. Plus, PhoneDisc business listings include 100% categorized SIC codes and provide more listings with Zip+4 than any other directory. In two independent studies conducted in April, PhoneDisc listings were found to be far more accurate than selectPhone. It's no wonder that *PC Computing* chose PhoneDisc as the best CD-ROM directory on its coveted "A-List" of the 17 hottest software titles for two months in a row!



"Easily the Best CD-Phone Directory You Can Buy"

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Designed for Windows® 95!

PhoneDisc is designed to take full advantage the exciting new features of Windows® 95, and has been approved by Microsoft® to carry the coveted Designed for Windows 95 logo. If you're running Windows 95, demand the Experts' Choice - PhoneDisc PowerFinder.

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216114	Fax	\$25
216116	Business Lite	\$25

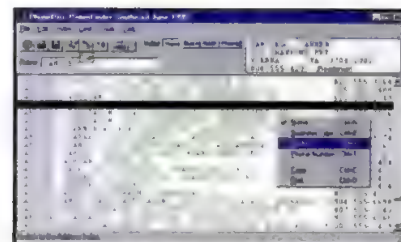


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The first thing you'll notice about PowerFinder is its lightning-fast search engine that searches as you type each letter. It's called

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Top-rated business directory with full reverse searching.



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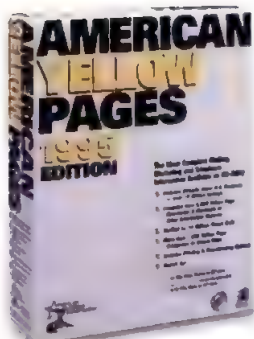
BUSINESS LITE
The affordable business directory... Search by name & business type.



The American Yellow Pages

The most accurate information costs less!

This easy to use product lets you search from over 7,500 Yellow Page Headings/SIC Codes. Just plug in the company name and you will get an entire company profile consisting of:



Company Name, Complete Address, Telephone FAX (where available), SIC Codes, Brand & Specialty Information, Years Listed in Database and Size of Yellow Page Ad. This great marketing reference tool even lets you download or print the information you need!

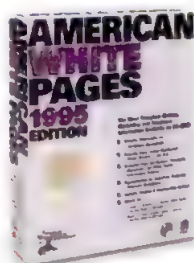
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Am. Yellow Pages
215779

The American White Pages on CD-ROM

The most complete mailing, marketing and telephone information you need on over 70 million U.S. households

No other residential phone book gives you this much information! Search by Median Home Value or Length of Residence by any City, State, or ZIP Code—or just type in the persons



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\$45

American White Pages
215775

The 70 Million Households Phone Book and The 11 Million Businesses Phone Book

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Access to this much information has never been so easy. Type in the name and up pops the phone number or you can reserve search. Type in the phone number and get the name. So whether you're in need of business or residential phone numbers these two great



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215772

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215773

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Software



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Phone Search USA is the first CD-ROM phone book created to work directly with Street Atlas USA mapping program. Of course, you can use it on its own and take advantage of its nationwide database of residential and business listings; but, when you run it with Street Atlas USA 3.0, you can actually map the location of individual listings!

- Unique link with Street Atlas USA 3.0



NEW!

- More up-to-date detail
- Street address search power
- Custom map editing
- Flexible printing options
- More practical applications, especially when you integrate it with Phone Search USA

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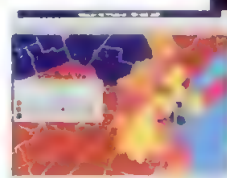
Street Atlas 3.0 CD
216106



- The most impressive search capabilities for the money
- Unlimited exporting of phone numbers to Street Atlas USA or other applications
- Comprehensive nationwide database of over 80 million residential and business listings

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Phone Search CD
216107



MapLinx™ for Windows

Turn confusing customer lists into eye-opening maps for profitable decision-making

Get a geographical picture of your business that your contact manager, spreadsheet or database simply can't deliver! Instantly turns your customer or prospect lists, sales figures or other business data into thought-provoking, colorful U.S. maps in seconds. Helps

you spot profitable opportunities you might otherwise overlook—before the competition has a clue! Use it to map your database records on pushpin-style maps. Or use the color coding capabilities to visually display and analyze sales levels, market activity and other data. easily exports your results into any other Windows application. MapLinx opens your eyes to profitable opportunities—yet costs thousands less than similar programs on the market!

\$85

MapLinx™ for Windows
269206



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Software

DELIRIA

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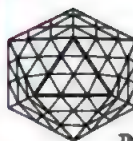


\$79

WinFax PRO 7.0
Win 95 3.5"
216200

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WinFax PRO 7.0
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216201



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MicroHelp

UnInstaller 3
Guaranteed to operate with Windows 95!

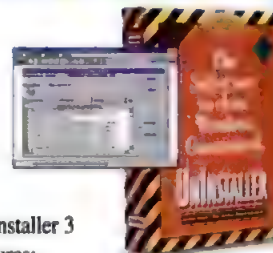
Every Windows® application places bits and pieces of itself in places you don't know about. UnInstaller™ safely and completely uninstalls applications, returning lost disk space and operating speed. UnInstaller's exclusive SmartLinks™ technology scans your system and learns how files are interrelated.

UnInstaller 3 features:

- Windows Cleanup
- Orphan Finder
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MicroHelp Uninstaller 3.0
SWRW3MI31



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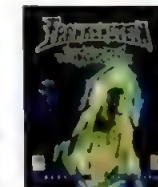
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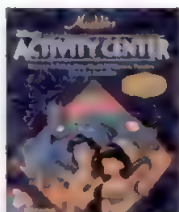
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- **Pre-Installation Tune-up** offers an easy, systematic method of diagnosing, repairing and fine tuning a system to prepare it for the installation of Windows 95 or any new application. Includes special DOS versions of SpaceWizard (frees disk space), Norton Disk Doctor

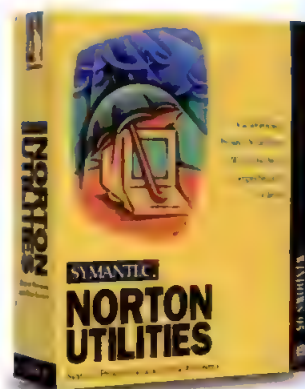
(tests file system and hard disk integrity), and Norton Diagnostics (comprehensive hardware diagnostics)

- **Norton System Doctor** makes your Windows 95 system self-tuning and takes the guesswork out of running utilities. Runs in the background, monitoring over 80 vital system resources and can automatically launch the appropriate utility to correct a problem
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- **Norton Disk Doctor** provides the most advanced diagnosis and repair of standard and compressed drives. Exclusive Partition Table and Boot Record tests.
- **Speed Disk** for faster system operation and improved

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Exclusive swap-file optimization and sorting by file access date improve system performance

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- **In Case of Emergency!** Includes a ready-made bootable Emergency Rescue Disk that will restart and repair your system even when Windows 95 won't load. Provides advanced data recovery (Disk Editor) and hardware diagnostics, along with DOS-mode versions of Norton Disk Doctor, Unformat and UnErase for emergency use. Image backs up vital system data structures for improved



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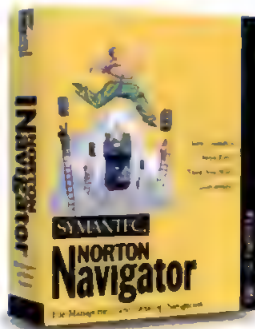
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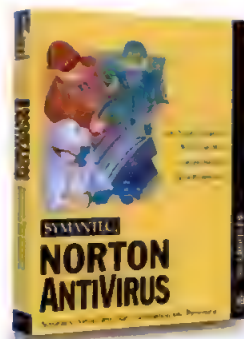
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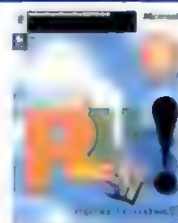
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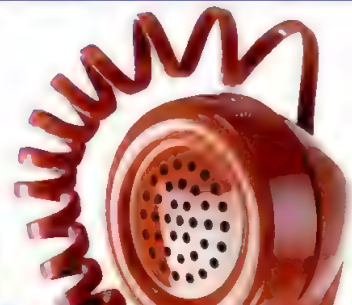
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M3243	4.3 GB SCSI	8.5 ms	512K	1015
M1801	9.0 GB SCSI	11 ms	512K	1955
M4221Wide	2.1 GB SCSI	8.5 ms	512K	855
M3243Wide	4.3 GB SCSI	8.5 ms	512K	1125
M1801Wide	9.0 GB SCSI	11 ms	512K	2055
M4221AV	2.1 GB SCSI	8.5 ms	512K	799
M3243AV	4.3 GB SCSI	8.5 ms	512K	1105
M1801AV	9.0 GB SCSI	11 ms	512K	2075

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Seagate

Model	Capacity	Type	Seek	Cache	Internal
Hawk 2LP	1.2 GB	SCSI	9.5ms	512K	395
Hawk 2	2.4 GB	SCSI	9ms	512K	649
Barracuda	2.4 GB	SCSI	9ms	1004K	855
Barracuda	4.2 GB	SCSI	9ms	1004K	1275
Barracuda Wide	4.2 GB	SCSI	9ms	1004K	955
Barracuda Wide	4.2 GB	SCSI	9ms	1004K	1375
Elite	9.0 GB	SCSI	11ms	512K	2095
ST3550A	850 MB	IDE	12ms	128K	195
ST51000A	1.2 GB	IDE	9ms	512K	230

Ask About External IDE Parallel cabinets.

Quantum

Model	Capacity	Interface	Seek	Cache	IDE	SCSI
Fireball	540 MB	IDE & SCSI	10 ms	128K	170	180
Lightning	730 MB	IDE & SCSI	11 ms	128K	n/a	195
Trailblazer	850 MB	IDE & SCSI	11 ms	128K	195	220
Fireball	1080 MB	IDE & SCSI	10 ms	128K	210	280
Capella	2.2 GB	SCSI	8 ms	1024K	n/a	675
Grand Prix	4200 MB	SCSI	8.8 ms	512K	n/a	975
Atlas	4.3 GB	SCSI	8 ms	2048K	n/a	1375

External SCSI units add \$60 comes complete.

Ask About External IDE Parallel cabinets.

CONNER

Model	Capacity	Type	Seek	Int.
CFP1080	1.0 GB	SCSI	10ms	290
CFP2107	2.1 GB	SCSI	8.8ms	695
CFP4207	4.2 GB	SCSI	9 ms	1025
CFP880	850 MB	IDE	14ms	190
CFP1275	1.2 GB	IDE	14ms	240

External SCSI units add \$60 comes complete.

Ask About External IDE Parallel cabinets.

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1322A	2.1 GB SCSI	95
1322K	4.3 GB SCSI	145
1342C	9.0 GB SCSI	235
1342C	9.0 GB SCSI	245
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2742K	4.3 GB SCSI	365
2742K	4.3 GB SCSI	375
2742K	4.3 GB SCSI	385
2742K	4.3 GB SCSI	395
2742K	4.3 GB SCSI	405
2742K	4.3 GB SCSI	415
2742K	4.3 GB SCSI	425
2742K	4.3 GB SCSI	435
2742K	4.3 GB SCSI	445
2742K	4.3 GB SCSI	455
2742K	4.3 GB SCSI	465
2742K	4.3 GB SCSI	475
2742K	4.3 GB SCSI	485
2742K	4.3 GB SCSI	495
2742K	4.3 GB SCSI	505
2742K	4.3 GB SCSI	515
2742K	4.3 GB SCSI	525
2742K	4.3 GB SCSI	535
2742K	4.3 GB SCSI	545
2742K	4.3 GB SCSI	555
2742K	4.3 GB SCSI	565
2742K	4.3 GB SCSI	575
2742K	4.3 GB SCSI	585
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2742K	4.3 GB SCSI	635
2742K	4.3 GB SCSI	645
2742K	4.3 GB SCSI	655
2742K	4.3 GB SCSI	665
2742K	4.3 GB SCSI	675
2742K	4.3 GB SCSI	685
2742K	4.3 GB SCSI	695
2742K	4.3 GB SCSI	705
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2742K	4.3 GB SCSI	775
2742K	4.3 GB SCSI	785
2742K	4.3 GB SCSI	795
2742K	4.3 GB SCSI	805
2742K	4.3 GB SCSI	815
2742K	4.3 GB SCSI	825
2742K	4.3 GB SCSI	835
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2742K	4.3 GB SCSI	1005
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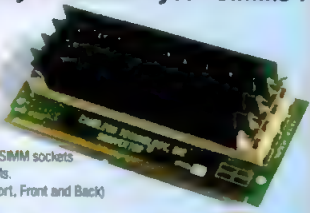
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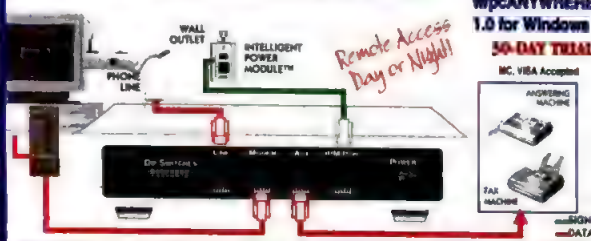
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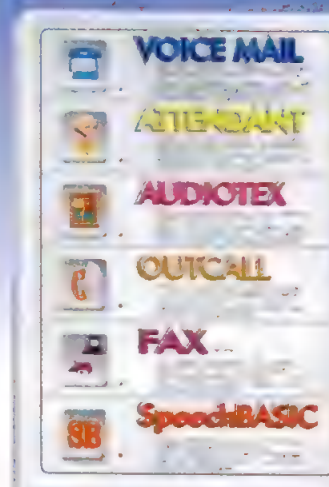


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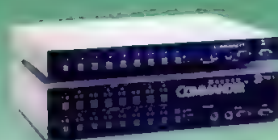


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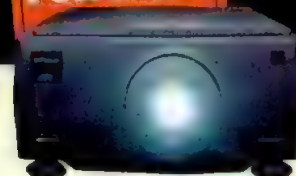


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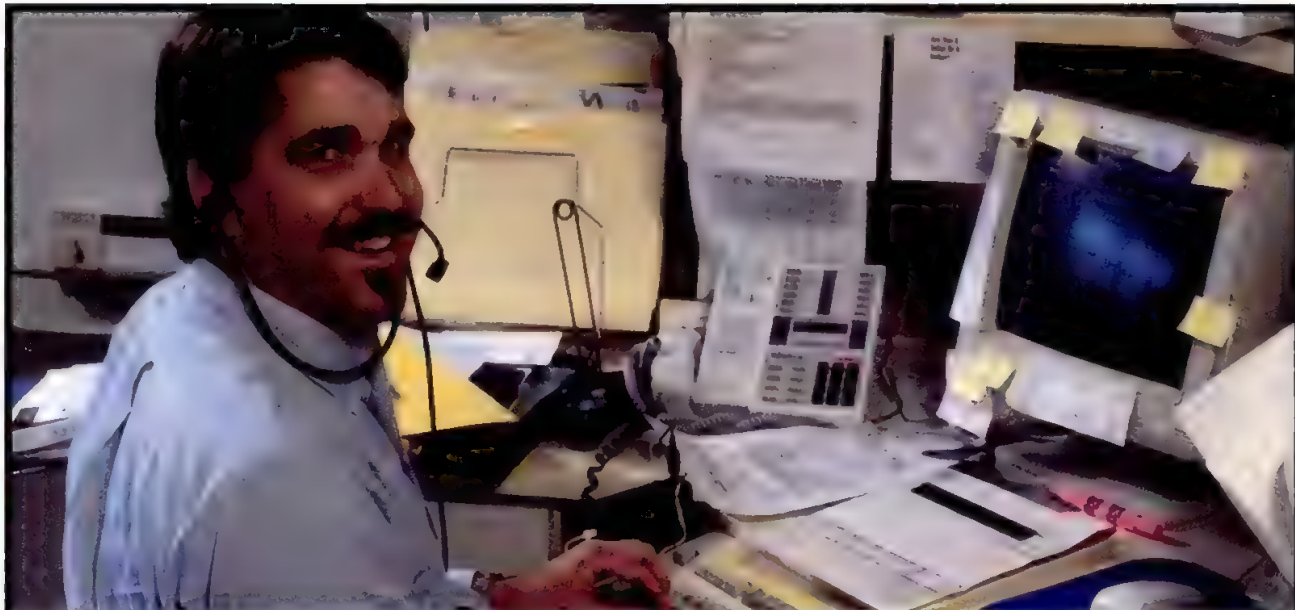
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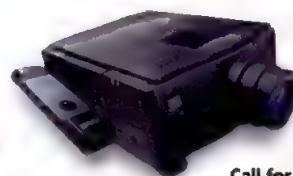
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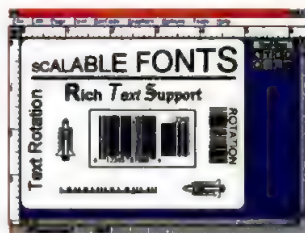


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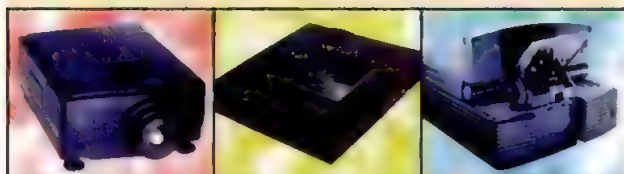


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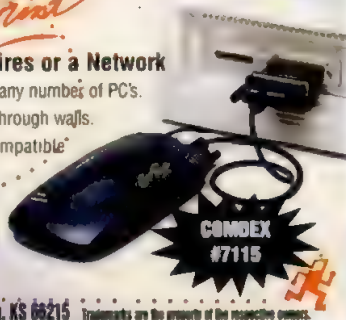
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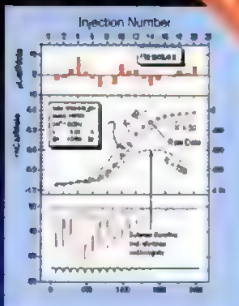
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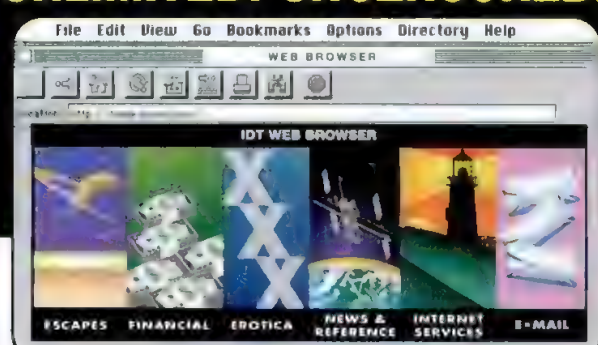
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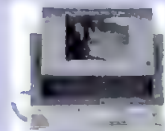
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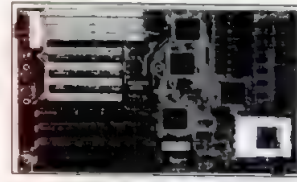
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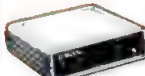
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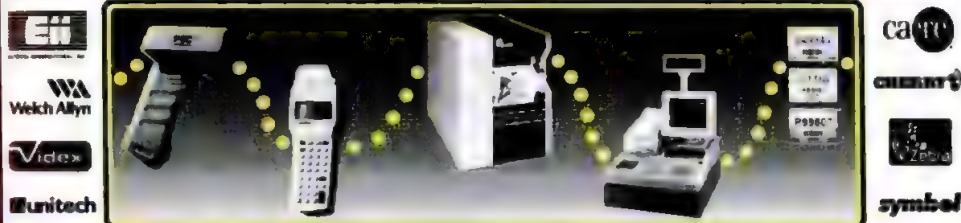
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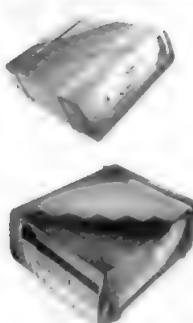
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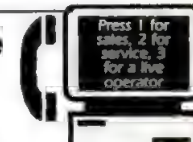
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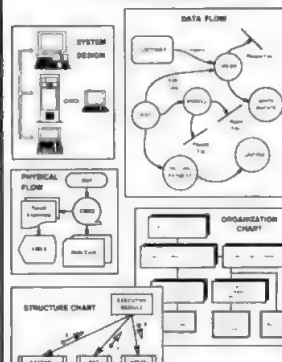
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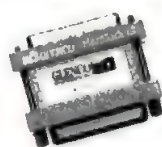
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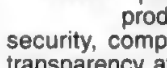
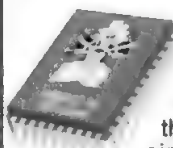
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After Hours

EDITOR'S RATINGS: ★ Poor ★★ Fair ★★★ Good ★★★★ Excellent



Four-Star Fun: CD-ROMs for Educating Kids of All Ages

The PC can be an excellent teaching tool for young children—provided you have decent educational software that can inform, challenge, and entertain. Well, you won't have to worry about any of that with these four CD-ROMs. All of them place the same

value on graphics, sound, and music as they do on content.

With puzzles ranging from basic alphabet lessons and word-learning exercises to complex brainteasers, each of these products should appeal to different age groups—and a few will even enthrall children of all ages.

Fisher-Price A-B-C's

Davidson & Associates;
800-545-7677.

Circle 511 on reader service card

★★★★ \$35.95

Fisher-Price A-B-C's is the first in a series of software titles that combine Fisher-Price characters with Davidson's multimedia and educational expertise. The program uses rhythm and rhymes to teach young children the alphabet and basic word skills.

Hosted by J.J. the Jukebox, Fisher-Price A-B-C's is lively, colorful, and "child-driven." Thanks to the straightforward design and

spoken instructions, young players can move through the various learning activities with little or no help from their parents.

The activities include Let-



J.J. The Jukebox uses rhymes and rhythm to teach alphabet and word skills.

ter Hip Hop (where you bring letters to life by clicking on them), Jingle Bebo (where

kids see and hear alliterative phrases such as "whales whistle" and "mice make muffins"), and Word Do-Wop (which helps teach kids how to create simple words, such as "mat" and "jam," by selecting letters on J.J.). Also, J.J. offers two modes of play: In Explore mode the child guides the action, and in Challenge mode the game prompts players to perform certain tasks.

This great title is rounded out by a Parent Tips section that explains the philosophy

and learning goals of each program activity, as well as an on-line word list that shows and speaks more than 175 words.

—Charles Taft

The Lost Mind of Dr. Brain

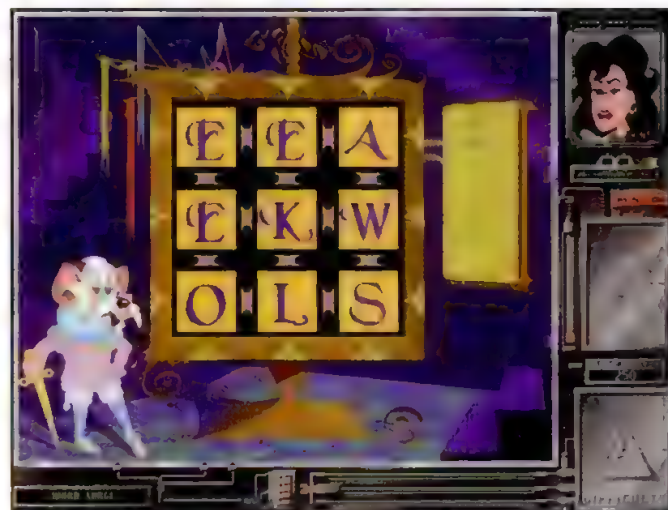
Sierra On-Line; 206-649-9800.

Circle 512 on reader service card

★★★★ \$49.95

Maybe Dr. Brain should have tested his brain-drain helmet before trying it out on his pet mouse, Rathbone. You see, instead of making Rathbone a little smarter, the helmet transferred *all* of the doctor's intelligence into the mouse. Now it's up to you to save the poor doctor by solving a series of puzzles in The Lost Mind of Dr. Brain.

Sierra claims to have used Dr. Howard Gardner's Theory of Multiple Intelligences to arrive at a balanced group of seven puzzles. We didn't see any evidence of scientific underpinnings, but we did see seven excellent, traditional



You have to solve some puzzles if you want to help Dr. Brain.

AFTER HOURS INDEX

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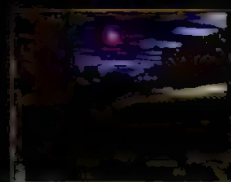
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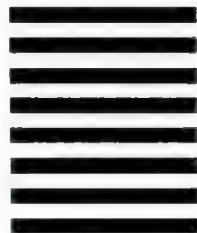
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Lincoln Millstein, *The Boston Globe*, June 16, 1995

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PC Magazine Editors' Choice, February 21, 1995

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After Hours

puzzles dressed up in imaginatively colorful garb. You'll run into mazes, word scrambles, and match-the-item challenges, all decked out in beautiful SVGA graphics.

You have to solve each puzzle not once but many times to restore Dr. Brain to his (somewhat) normal self. For help along the way, Dr. Elaina (Dr. Brain's niece and world-renowned neurosurgeon) will offer hints. Also, you can select one of three difficulty settings.

The Lost Mind of Dr. Brain continues Sierra's current trend of Windows-specific ti-

freshes are handled much faster than they were in the last King's Quest release.

In short, The Lost Mind is yet another welcome addition to the clever, challenging, and entertaining Dr. Brain series.
—Barry Brenesal

Louis Cat Orze

IVI Publishing; 800-432-1332.

Circle 513 on reader service card

★★★★    \$49.95

The year is 1697; the place, Versailles. Mary Adelaide, Princess of Savoy, is being presented with a rare necklace by Louis XIV. But the necklace is missing, and you've been hired to investigate—by the king's cat, Louis Cat Orze.

This may sound a little strange, but Louis Cat Orze is a great discovery tool for learning all about the culture of Versailles during its most sparkling era. Over a six-day period, you'll observe dozens of suspects and tinker with countless objects, each of which are linked to interest-

ing tidbits of information.

To pay your way through town, you play a card game that is actually an information quiz with rewards for correct answers (and no penalties for wrong ones). You can visit the Library, the Hall of Portraits (which has pictures and biographical information on many important figures from the period), and the Map Room (which contains various maps from the late seventeenth century).

Visually, Louis Cat Orze sacrifices flow for detail. The animation is a bit jerky and the voices are somewhat inconsistent (some characters have accents, some don't). The music, however, is outstanding, and the examples of everyday life in Versailles are delightful.

For its writing, charm, and variety of overall period content, Louis Cat Orze is one of the most imaginative, educational, and entertaining titles we've seen to date.

—Barry Brenesal

Read, Write, and Type

The Learning Company;
800-852-2255.

Circle 514 on reader service card

★★★★    \$59.95

In the Age of Computers, reading and writing have been joined by typing as the basic skills necessary for literary communications. What better way to learn these skills than through a



Read, Write, and Type helps teach kids about literary communications.

product called Read, Write, and Type.

This interactive adventure takes place in the Land of the Storytellers, characters who live behind the keyboard's 26 alphabet keys. All is well until Vexor the Virus arrives, scaring the inhabitants and stealing their letters to lock them in their homes.

The player must beat Vexor at a variety of games in order to win back the letters and free the Storytellers. For example, in the Downtown Sounds game, Vexor displays various pictures. To thwart Vexor, your child will have to tap keys that correspond to specific letters or sounds associated with those pictures.

Even after the letters are freed in Read, Write, and Type, the games continue. The Power Fountain lets players demonstrate typing speed and accuracy, with the reward being a shower of



Louis Cat Orze challenges you to solve a seventeenth-century mystery.

tles. So far, the trend is a good one, as the SVGA graphics are excellent and screen re-

The Hubble Space Telescope CD-ROM

Although it was originally branded by critics as The Rubble Telescope in honor of Fred Flintstone's dim-witted sidekick, this multibillion-dollar project still managed to reveal astonishing intergalactic secrets even before the mirrors were corrected.

Now, you can get a look at the same images on your PC. Best of all, you can do it for a fraction of what the government paid. The Hubble Space Telescope CD-ROM Archive features QuickTime movies, revealing text, and actual photos taken with Hubble that detail the telescope's fascinating view of the universe.

Astronomy fans will love the special section on the Shoemaker-Levy Comet collision with Jupiter.

There's even a convenient Internet tutorial that shows you how to find and download your own Hubble

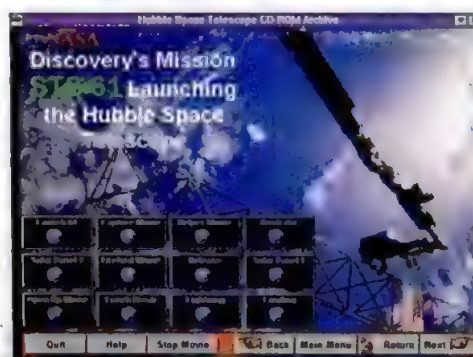
photos direct from NASA's Internet site.

—Shane Mooney

Brantwood Interactive; 800-782-8892, 818-879-9090.

Circle 510 on reader service card

★★★★    \$29.95



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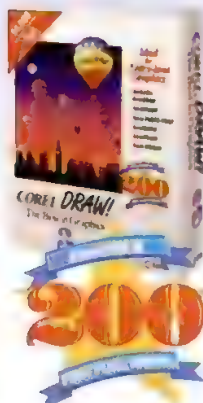
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After Hours

water that rains over Vexor. And the Bonus Blimp offers children a chance to raise their scores with increased challenges.

Read, Write, and Type supplies other imaginatively designed incentives for kids to improve their typing skills. In the E-Mail Tower, for example, children can send pretend e-mail to imaginary pen pals and even receive automated replies. It adds to the general feeling that literary communication is fun.

Finally, a settings menu lets you choose from first-, second-, or third-grade reading levels and among several typing-difficulty levels for the Power Fountain game.

Read, Write, and Type? It should be called Read, Write, Type, and Entertain. This program has it all.

—Barry Brenesal

Kids

It's Uncanny Art, Bub

X-Men Comic Creator

Knowledge Adventure;
800-542-4240, 818-246-5604.

Circle 515 on reader service card

★★★   \$29.95

Are your kids fans of the X-Men? Are you? Well, thanks to the X-Men Comic Creator, you can both get the chance to create and animate your own X-Men stories on the PC. Not only can you create great-looking still illustrations, but you can enhance them with sound, music, and even animation.

Like a standard drawing package, the X-Men Comic Creator comes with lots of clip

QUICK CLIPS

Recommended
It's Your Call
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Follow That Sleigh!

Who can resist Claymation characters, especially when they're this perky? In addition to the cute characters, there are loads of activities guaranteed to get kids in the holiday spirit. \$34.95; GT Interactive Software; 212-726-6500.

The Alchemist

This beautifully animated, fabulously cryptic Tarot-like reader and adviser may cost more than a trip to your local mystic, but it's a whole lot more convenient—and more fun, too. \$49.95; Interactive Inc.; 800-452-9999.

Fisher-Price Dream Doll House

This point-and-click toy is adorable and easy to explore. But why should you buy a CD-ROM when your child would probably have a whole lot more fun playing with a real doll house? \$35; Davidson & Associates Inc.; 800-545-7677.

A Little Painter Lite

A neat little program that plays soothing music while your kids color savage jungle pictures on the PC. Sure, the price is low and the pictures are beautiful, but it just feels like this one should do more. \$19.95; PSG-HomeCraft Software; 800-207-7735.

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After Hours



X-Men Comic Creator lets you create your own mutant mayhem.

art, including backgrounds, stamps, and animations.

As if that weren't enough, you can even use this program with Knowledge Adventure's Spiderman Comic Creator, so you can team up Spidey and Wolverine to defeat Magneto.

The animation is a little jerky, so your cartoon won't look as good as the Saturday morning offerings. Then again, those shows don't have to run under Windows.

—Shane Mooney

Adventure Those Silly Boozooks

Woodruff and the Schnibble

Sierra On-Line; 206-649-9800.

Circle 516 on reader service card

★★★★ \$39.95

In the distant future, a new race evolves on Earth—the amiable Boozooks. But the



Turn off your Tobozon and help Woodruff find Azimuth.

humans mistake the Boozooks for warriors and conquer them. It's understandable, then, that Boozook professor Azimuth would want to unleash the Schnibble—a powerful magic that will cause peace and prosperity to flourish. Azimuth has been kidnapped.

In Woodruff and the Schnibble, you take the role of Azimuth's young friend Woodruff. Abandoned and illiterate, Woodruff must find and free the professor, reveal the forgot-

ten Syllables to the Boozook Wise Men, and help the Boozook king escape the lure of his Tobozon (television).

During the game, plenty of well-recorded voices help bring the Boozook civilization to life. The graphics resemble old Fleischer Brothers cartoons of the '30s, and the animation is excellent.

This is a delightfully silly game. It's tough to beat and impossible to abandon.

—Barry Brenesal

SPOTLIGHT ON ADVENTURE

Buried in Time

Buried In Time: The Journeyman Project 2 is a stunning interactive tale of time-travel and intrigue. Its photo realistic backgrounds, live-action video, quirky humor, and wealth of historical detail combine to immerse the player utterly in the action. Of course, you'll need a thoroughly modern multimedia Windows system to run this three-CD-ROM extravaganza.

The story begins in the year 2319 with a visit from . . . yourself, appearing from ten years in the future. As Agent 5 of the Temporal Protectorate, your job is to research history and prevent any changes to the past. Your future self has been charged falsely with altering history. He's under arrest,

but you're not. Using the time-jump suit he provides, you can investigate four sites and discover the truth.

At each site, you'll gather evidence and objects while solving puzzles. You'll make offerings to Mayan gods,



scale a castle wall, build a contraption from Da Vinci's notes, and mine an asteroid for ice. Keep your eyes open; some of the objects you need are tiny and easy to miss.

The puzzles are tough, but you can jump to another site if you get stuck. Also, a puzzle-free walk-through mode lets you experience the full story without frustration. Either way, Buried in Time will provide many hours of entertainment.—Neil J. Rubenking

Sanctuary Woods; 800-943-3664, 415-286-6100.

Circle 524 on reader service card

★★★★ \$64.95



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Coming Up

Technical Excellence Awards

PC Magazine's annual Awards for Technical Excellence honor the very best of the superb hardware and software that brought the industry to new heights in 1995. We also honor computing's most brilliant and distinguished people, who brought these creations to fruition. As PC Magazine's coveted Awards for Technical Excellence enter their twelfth year, the pace of innovation in the PC industry has never been faster, nor the results more impressive.

Fast Ethernet Adapters

Sooner or later you'll need to kick your network speed up to 100 Mbps. Since it's too expensive to replace your entire 10Base-T network overnight, consider hybrid 10/100 Fast Ethernet cards. They function at 10 Mbps and jump to Fast Ethernet when you're ready to go to 100 Mbps—some with more grace than others. We test 20 Fast Ethernet network adapters that will grow with your network. We also check in on 100VG-AnyLAN, the 100-Mbps transmission standard developed by Hewlett-Packard, and review the progress of ATM (asynchronous transfer mode)—the future standard of high-speed networking.

Home PCs

Planning to put a new computer for your family or your home office on your holiday shopping list this year? In this roundup of 32 home-oriented PCs, we evaluate all the pieces of the home PC puzzle, including ease of setup, software bundles and compatibility, CD-ROM drives, speakers and sound cards, and telephony features. So whether you're looking for a processing powerhouse to crunch your spreadsheets or a system your kids can use to do their homework and surf the Net, chances are you'll find it here.

Holiday Gift Guide

The holidays are approaching fast. You need gift ideas, and you need them soon. Never fear: Our second annual Holiday Gift Guide covers 101 of the hottest games, gifts, and gadgets available this buying season. We cover everything from children's programs and personal productivity titles to the latest, greatest shoot-'em-ups. The Gift Guide: Don't go shopping without it.

Personal SQL

Some of the world's most powerful SQL database engines have been scaled down to the point where they can run on a laptop. Yet they remain compatible with and share many of the features of their giant enterprise-level siblings. We take an in-depth technical look at personal SQL products from Gupta, Oracle, and Sybase.

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

AOL Just Won't Stop

Once again, a bizarre randomly assigned password from America Online has crossed our desk. This time, it's COLIC-COMING.



Hmmmm, now which one of these training tapes tells me how to turn the computer on? (DataCal catalog.)

Classified Intelligence

"For sale: Microsoft ear drill, Lorad M-2 mammographic, Cottole dual channel rhinomanometer."—*THE CARNRICK CLASSIFIED*

"Wanted: Secretary. Monday, Wednesday, Friday. Knowledge of WordPerfect, four windows required."—*PENNYSAVER* (YORKTOWN, NEW YORK)



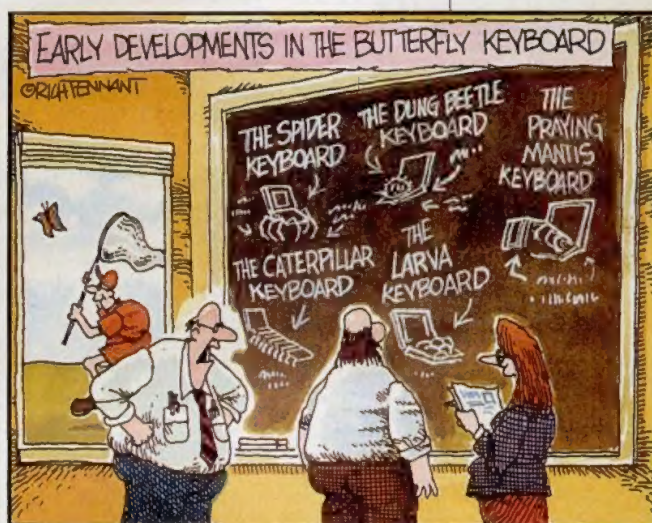
Let's see... I put my knee here and my elbow there. No, I put my butt here and my arm there. No, that's not it, either. (Service Merchandise catalog.)

Pause for the Clause

Microsoft VP Brad Silverberg didn't say quite what he meant when he wrote this note to Windows 95 beta testers: "We learned things about the product that we needed to fix. As a result we have improved setup and our support for your existing software and hardware. Along the way we fixed many bugs that have helped us improve the product."



Wow. Get ready for some wild nights in Portland! (Microsoft brochure.)



"WHERE'S THAT FLAKE TEMPLEMAN? HE'S SUPPOSED TO BE HELPING US WITH THIS."

If your entry is used, we'll send you \$50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802. Winners this issue: Greg Andrews, Kevin Donachie, J. Randolph Hecht, Lei Lani Heger, William Krumske, William Luken, and Matt Reismeyer.

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